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WAR EFFORTS AND THE KEY INDUSTRIES OF INDIA

THE rapid rise to power of countries organised in deadly earnest has been the marvel of the last decade; and the technique of warfare developed in these countries has hardly been less revolutionary than the technique of the organisation of the State. The democratic governments could only look wistfully at this war preparation of the totalitarian States, for they could not secure the whole-hearted co-operation of all sections of the people in counter-preparation until they could rouse popular enthusiasm with the slogan "our country is in danger". In India, the most important political party professed faith in complete non-violence; and the other parties have been reluctant to lend their support to additional military expenditure on the ground that so long as India remains a dependency and her sons have no effective voice in military administration, defence of India is an imperial problem of Great Britain and that Indian defence forces are no concern of the people of India. The fateful events that have followed the German conquest of the small neutral nations of Western Europe and the complete collapse of France have rudely awakened us to the danger which the victory of totalitarian States exposes us to; and there has developed a genuine interest in the war-efforts of the country. Uninformed criticism has

even swung to the opposite extreme. People are not wanting who question the adequacy of a war-effort which is intended to expand the army of this vast country by 130,000 men, when during 1914–18 nearly a million combatants were sent overseas from India. This arises from a failure to appreciate how completely 1940–41 differs from 1914–18. Then massed infantry and cavalry equipped with rifles, supported by artillery and machine-gun units and maintained by animal transport were fully competent to deal with the enemy, and were in fact the main weapons of offence. Air power was important, but was only a side-show, and the use of mechanised vehicles was in a very elementary stage. To-day, military science has been revolutionised. Riflemen are of little value unless used in co-operation with more highly technical mechanised arms. The German army easily broke through the French line by striking with armoured divisions supported by dive-bombers from air and by well-equipped machine-gun men on motor vehicles. Finally came the mass of foot soldiers to hold and consolidate the ground already gained. The adequacy of military preparations is therefore not to be judged by the recruitment of new combatants, but by the expansion of the production of modern munitions of all kinds. It has been estimated that a single active combatant in the field requires 10 tons of equipment in order that he may be effective, and that munitions include 60,000 items of materials and supplies of which India can produce only 30,000 items.

This view-point was emphasised more than a year ago in a broadcast by H. E. Sir Robert Cassels; when he lamented that India's industrial backwardness stood in the way of adequate military preparation. "India's greatest asset is a large supply of the finest types of fighting men. Her great weaknesses are a low national income and a limited industrial development, incapable as yet of supplying the technical equipment of a modern army. History has amply shown that victory is not the prerogative of a large organisation swollen with ill-armed soldiery, but rather of small well-equipped armies modern for their period. This is even more true to-day than it was at any time before, and now-a-days large ill-equipped armies are nothing more than sheep for slaughter." Indeed this difficulty was realised by the Chatfield Committee which made an exhaustive enquiry into the problems of Indian defence about three years ago. They concluded that the ordnance factories were woefully inadequate and recommended their immediate expansion at a cost of about 7 crores of rupees. The British Government even agreed to defray a part of this capital expenditure by a generous subvention. It is indeed significant that General Auchinleck, the Secretary-Member of the Chatfield Committee, should have been appointed the Commander-in-Chief in India in succession to Sir Robert Cassels. This selection justifies the belief that the programme of mechanisation together with the development of those industrial resources which are needed for defence will receive in future infinitely more attention from the Government of India than in the past.

It is no use ignoring the fact that the Indian nationalists have a grievance against the Government of India for their lack of foresight in handling problems of industrial development. Under the stress of the war

of 1914, the Government of India declared in 1915 that India was entitled to receive all the support that a Government could give in order to enable her to take a leading position among the manufacturing countries of the world. But the lessons of that war were soon forgotten. As Sir Ardeshir Dalal made a pointed reference in his Presidential Speech at the last Science Congress, the industries created by the last war languished and died in the post-war period for want of encouragement and protection from Government. It will be unfair to maintain that the Government were altogether blind to these tragic happenings. A Fiscal Commission was appointed, and in accordance with its recommendations, a policy of discriminating protection was adopted. Only those infant industries were protected which would in the long run be able to dispense with protection. The result has been that industries came into being which could command an abundant supply of raw materials and a ready market for finished products within the country itself. Thus in 1938–39, cotton manufactures stood at 920 million lbs. and cotton piece-goods at 4,200 million yards. Paper registered a production of 1·35 million cwt. in 1939–40. Match industry has maintained itself under protection, and India is producing more sugar than her current requirements. And even unhelped by tariffs, the production of cement has gone up from 1,000 tons in 1914 to more than a million tons in the current year. But we are fast approaching a limit to such expansion in the home production of consumer's goods. Indian produce such as jute, tea, cotton, hide and oil-seeds have got to seek a market abroad with the result that a trade balance has to be maintained by import of a certain minimum of consumer's goods. An increase in national income and a consequential increase in the *per capita* consumption of manufactured goods would have been a way out of the difficulty. But this unfortunately has not come to pass; and the gains from industries producing consumer's goods have been offset by the difficulties of the masses whose agricultural products are fetching lower prices and are having shrinking foreign markets.

The way out of this impasse, which is also a solution of the difficulties that are hampering our defence preparations, lies in the establishment of key industries. Adopting a division which is convenient in practice, one can speak of a category of industries and services that supply materials to other industries rather than to the individual consumer, industries that are calculated to improve the capital equipment of the country. The nation has till now been content to produce some types of consumer's goods with the aid of foreign machinery. But, from the point of view of sustained progress, the development of key industries is of paramount importance. The metallurgical industries, the engineering and machine tool industries, the chemical industries and the transportation industries broadly cover this category. In war time, the output of these industries are closely integrated with that of Ordnance and Armament factories which are directly managed by the State for the production of munitions. Leaving aside actual training of combatants, war effort becomes synonymous with expansion in the production of munitions by bringing into being these new industries or very rapid development of such of them as are already in existence.

The vision and enterprise of the Tatas have given India one key industry which is proving of incalculable value in the present crisis. Under the stimulus of the war, the Tatas have increased their production of steel in 1939–40 to more than a million tons. The Bengal Steel Corporation and the Mysore Iron and Steel Works will, between them, be soon responsible for the production of another 300,000 tons of steel. The possibilities of India as maker of steel are immense. Indian ores are rich and within easy distance of coal deposits. Limestone, dolomite, manganese and chromite are plentiful. There is no reason why India should not supply all the steel requirements of the countries represented in the Eastern Group Conference. At Jamshedpur have just been installed two five-ton electric furnaces for the manufacture of the superior quality of alloy steel required by the Defence Department, and similar steps for producing high grade steel have been taken in the Mysore Steel Works. Manufacture of armour plates which have passed the Army tests has been taken in hand and Acid Steel of superior quality has also been just produced from Indian pig iron; this successful development is likely to have far-reaching effects on the manufacture in India of locomotives, railway wheels, tyres and axles for which acid steel is specified. The manufacture of tin plate is making good progress, and the Indian Steel and Wire Products Co., are turning out 50,000 tons of bars, rods and wire nails per annum.

While India is rapidly developing her capacity for the production of iron and steel, the progress of the other metallurgical industries has been disappointing. The Indian Copper Corporation only produces a fraction of the country's requirements, while aluminium, nickel, lead, zinc, tungsten and other important metals have all been imported till now. Good deposits of nickel are stated to have been found in Nepal, but they are in areas too inaccessible for successful working. Under the stress of the war, the Government of India has promised to grant protection to the aluminium industry in future; and as a result the Aluminium Production Co. of India, Ltd., are establishing an aluminium smelter in Travancore of an ultimate capacity of 5,000 tons per year. Electric power will be supplied by the Travancore State at a very favourable rate. Steps have been taken to acquire suitable deposits of bauxite from which alumina will be manufactured locally. A sheet rolling mill for the production of aluminium sheet has also been erected near Calcutta. The increasing output of munitions of all kinds with the possibility of construction of ships, tanks, motor vehicles and aircraft in India will all make demands on the aluminium industry which, it is hoped, will be met from sources within the country. Apart from this aluminium industry in the making, no visible progress has yet been made in establishing other non-ferrous metallurgical industries.

If our progress in non-ferrous metallurgical industries has been disappointing, our progress in engineering and machine tool industries has been still more so. In 1938–39, India imported machinery and mill work worth 19 crores of rupees, instruments and scientific appliances worth 6 crores of rupees, and even belting for machinery worth 50 lakhs of rupees. Besides the railway workshops, the engineering industries are mostly located around Calcutta and Bombay and give employment to nearly

300,000 persons. They specialise in fabricating structural steel work like bridges and storage tanks, and also supply part of the country's demand for engineering stores in the textile, tea, mining and sugar industries. Small beginnings have also been made in the manufacture of workshop machines, low horse-power electric motors, transformers and electrical lamps. The Government has appointed a Director-General of Engineering Supplies with headquarters at Calcutta; and a special advisory committee has been set up to serve as liaison between Government and the Industry. The people of India are, however, suspicious that some "bottlenecks" exist in the engineering industry behind the scenes, and they are convinced that conscious purposeful direction can produce vast changes. Already there are pointers in the right direction. The growth of these industries has been largely retarded by the inadequate facilities for training of craftsmen and the limited use of apprenticeship facilities. Active remedial measures are being adopted; and schemes for the annual training of 4,000 skilled mechanics in the various technical and scientific institutes of the country at the expense of the Government of India have been sanctioned. These industries were hard hit in the slump that followed the war of 1914. Once bitten, twice shy. They have now to be created by a Government with imagination. This is a war where machines and munitions count more than men, and no extraneous interests should be allowed to hamper the attainment of India's self-sufficiency in this field. And once created for war purposes, these industries, we hope, will in peace time, convert swords into plough shares: and the future Government of India, we also hope, will not hesitate to fulfil the pledge which Sir A. Ramaswamy Mudaliar gave in March 1940: "In case we, in any form, encourage the development of industries for our war needs, we shall make it clear that at the end of the war, those entrepreneurs who had come to the assistance of the State would not be left high and dry to take care of themselves."

The heavy chemical industries of India are rapidly getting in the way of production and may soon satisfy a large part of the country's requirements. Even before the war began, most of the acids and salts were being manufactured in India. It is also welcome news that there are deposits of sulphur in Baluchistan and deposits of pyrites in Simla hills, Behar and Hyderabad, which can be drawn upon for manufacturing sulphuric acid if the foreign supply of sulphur were, for any reason, cut off. Some of the paper and textile mills are producing alkali and bleaching powder for their own requirements. With commendable vision, the Mysore Chemicals and Fertilisers have put up a plant for the production of synthetic ammonia and ammonium sulphate with a capacity of 6,000 tons a year. The Mettur Chemicals will also soon be producing large quantities of chlorine, bleaching powder and caustic soda. But the biggest development in the field has been the establishment of two factories one in the neighbourhood of Calcutta by the Imperial Chemical Industries, Ltd., and the other in Kathiawar by the Tata Chemicals, Ltd., which was started with an authorised capital of Rs. 5 crores of which Rs. 1¼ crores were issued in 1939. These huge concerns aim at producing at an early date in the country itself all our requirements of acids, alkalis, bleaching materials and artificial fertilisers, like potassium and ammonium sulphate.

It is an entirely different tale when we

consider the dye-stuff and synthetic drug industry. The import of dyeing and tanning materials amounted to 3·9 crores of rupees in 1937–38, more than 60 per cent. of the supplies coming from Germany. In September 1939, the Indian Millowners, in anticipation of war, had laid by considerable stocks of dyestuffs, and also the stock of German dyestuff in Bombay, which was confiscated, as enemy property, was found to be of very considerable magnitude. If, however, the contingency were to arise that maritime communications with Britain were seriously dislocated, practically all the dye-houses in India will have to close down. The history of the British dye-stuff industry should be an object lesson to us in our present situation. Before 1914, Great Britain did not possess a dye-stuff industry of any importance, over 90 per cent. of the dyes used being imported from Germany. As the last war progressed, the situation became very serious and it was realised that British dependence on Germany for dyes was tantamount to a much wider and more fundamental weakness of British Chemical Industry, as the production of dyes was intimately connected with the production of chemicals in general. Modern war depends for its successful prosecution on an abundant supply of an infinite variety of chemicals; and a dye-stuff and a fine chemical industry must be considered an integral part of every defence programme. The British Government took immediate and far-reaching steps. Beginning with a direct and large subsidy for the formation of a company which ultimately was absorbed in the Imperial Chemical Industries, millions of pounds were spent on the rapid development of every branch of the industry. Later on, the importation of dyes and even intermediates was prohibited. As a result, the British dye-stuff factories are now producing over 90 per cent. of their home requirements and have in addition a considerable export trade. The Government of India have just set up a plant for the recovery of toluene and benzene from coal-tar at a cost of 16 lakhs of rupees; and the Hon'ble the Commerce Member has announced that he would soon appoint an expert committee to explore the possibilities of establishing a Dye-stuff and Fine Chemical Industry in India. It is to be hoped that the Government of India will follow in the footsteps of the enlightened Government of Great Britain in this matter and that before long, this vital key industry will form a part of the capital equipment of Industrial India.

In India, the railways are either owned or controlled by the State while air transport services are in receipt of considerable subsidy. The railway workshops and the private engineering industries practically manufacture the whole of the rolling stock excepting locomotives. Sir M. Visvesvaraya lamented that no progress had been made in the manufacture of locomotives in India, even though in Mysore a metre gauge engine was built many years ago, and the railway workshops at Ajmere were capable of doing this job successfully. Under the continuous pressure of public opinion, Government decided just before the war to start manufacture of metre gauge engines at Ajmere and broad gauge engines at Kancharapara. But the war has upset these plans, as these workshops are now needed to manufacture more urgent munitions.

The Chairman of the Tata Iron & Steel Co., several years ago expressed the hope

that the steel plates manufactured at Jamshedpur might be used for ship building in the yards of Calcutta. This dream has not yet been realised. The yards at Calcutta are even now not capable of building launches and tugs of more than 1,500 tons, and manufacture of ocean-going vessels is absolutely beyond their capacity. The proposals for building shipyards have not yet received the support and encouragement which are necessary for their speedy accomplishment. The Scindia Steam Navigation Co., has however just taken up this enterprise in real earnest and in spite of the indifference of the Government is going ahead with the project of establishing a ship-building yard in the new harbour of Vizagapatam.

Nor has Indian war effort reached a stage when the ability to build aeroplanes and automobiles is considered essential. It is in these spheres, that the difference between war effort as it is and war effort as it should be, is most glaring. The Defence Department even a few months ago, was of the opinion that it was quite useless for the purposes of the present war to imagine the possibility of developments in these directions. Thanks, however, to the keen interest and the financial assistance of the Mysore State, Mr. Walchand Hirachand is putting up an Aircraft Factory in the neighbourhood of Bangalore. The American technicians in charge hope to produce aeroplanes from this factory in six months. The scheme for establishing an Automobile Industry in Bombay has not made much headway even though the project was mooted by Sir M. Visvesvarava in 1935, and a detailed report submitted in April 1936. It was intended to manufacture 11,000 vehicles every year in a factory with a capital outlay of 2¼ crores of rupees. The Indian Industrialists are obsessed with the fear that the manufacture of motor vehicles is too difficult to be undertaken by Indian workmen in the near future. They forget however, that the thought and skill required in manufacture have been transferred from workmen to automatic machines. Russia started the manufacture of motor vehicles about 7 years ago and produced 200,000 vehicles in 1938. Immediately on the declaration of the war, the Australian Government passed a Motor Vehicle Bounty Act, which provided for a bounty of 1½ million pounds for the first 60,000 automobiles manufactured in this country. The Government of India are not yet satisfied that the proposals for a motor car industry would be conducive to war effort. There is a silver lining however, in that non-official British opinion in India is now very strongly in favour of starting these industries. In an article on the 15th November 1940. *The Statesman* urged that Indian production of aircraft, ocean-going ships and motor engines was "fundamental and inescapable, and if we fail to do these things we do so at our peril". It advocated the wholesale transference of some factories from Great Britain to India as it sometimes "ceases to be good policy to put up factories to be knocked down and to seek new sites in a small island where work is for ever being interefered with from the air". They say that great responsibilities and small minds go ill together; there is no lack of complications in Eastern Asia; and the people of India hope that in these vital matters of key industries, the decisions of the Government of India will be guided by a national outlook and by a bold, constructive and vigorous programme which will make the defences of India as invulnerable as is humanly possible.

J. C. GHOSH.

A BRIEF SURVEY OF INDUSTRIAL RESEARCH CARRIED OUT IN INDIA*

IN response to a circular issued by the Board of Scientific and Industrial Research, accounts of technical investigations completed and persued in the various laboratories in the country were received. Based on this information, the Board has compiled a useful and revealing summary of the present position with regard to industrial research.

The survey has confirmed "the view generally held that really very little new has been accomplished by teaching institutions in the way of practical applications of science". Barring a few, the universities have not concentrated on the practical applications of science to industry and in spite of the brave efforts, some of the universities have put up to make science a living reality, the finances and the preoccupation of the teachers and the researchers in matters academic, have prevented them from contributing their best to the field of industry.

During the last twelve months, however, the Board of Scientific and Industrial Research, under the inspiring and energetic leadership of Sir S. S. Bhatnagar, has sought to encourage industrial research in the universities by providing the necessary funds and personnel.

The survey has brought into prominent relief another fact which deserves careful scrutiny. In the matter of selecting problems for industrial research, no plan appears to have determined the choice. This has resulted in an unnecessary duplication of effort. Now that a central Board of Scientific and Industrial Research has been constituted, it should be possible to reorganise and promote industrial research in the country with a view to avoid any duplication of work. The Board will no doubt soon take up this task of reorganisation not only to prevent wasteful duplication but also to secure allocation and distribution of work with a view to obtain results in the shortest possible period. The availability of competent personnel and material facilities and the proximity of a related industry should constitute the principal factors in determining the most suitable centre for promoting a particular piece of research.

It would be advisable to issue periodical (half yearly) reports of the progress of these researches.

* With grateful acknowledgments to the Board of Scientific and Industrial Research.

SIR P. C. RAY'S BIRTHDAY CELEBRATIONS

AN appeal for funds to commemorate the 80th Birthday of **Sir P. C. Ray** has been issued under the signature of 72 prominent Indians and Europeans all over India. The appeal states, "On the occasion of the completion of the 80th year of Sir Prafulla Chandra Ray (August 7, 1941), it has been proposed by his friends, admirers and ex-pupils to raise a fund with which his name will be associated. The income of the fund will be devoted to the furtherance of scientific and industrial research in India, a cause which Sir P. C. Ray has advocated all his life". Considering the position which Sir P. C. Ray occupies in the scientific life of India, we have no doubt that the response for this appeal will be both generous and extensive.

The Commercial Museum of the Corporation of Calcutta, has decided to celebrate the Birthday of Sir P. C. Ray by organising an exhibition of chemical and pharmaceutical industries in India. An influential Advisory Board with Dr. B. C. Guha as Chairman has been formed to organise the exhibition. A special feature of the exhibition will be the practical demonstration of industrial processes worked out in various Universities and in Technological and Scientific institutions of India.

The exhibition will be opened on the 21st March, and will be kept open for a fortnight. The organisers cordially invite the co-operation of the scientists and will be glad to allot the required space for exhibits and provide all facilities for demonstrating the processes worked out by them. Communications relating to this exhibition should be addressed to Jnananjan Niyogi, Esq., Officer-in-charge, Commercial Museum, Corporation of Calcutta, College Street, Calcutta.

YAUDHEYA COIN MOULDS FROM SUNET, NEAR LUDHIANA IN THE SUTLEJ VALLEY

BY

B. SAHNI, Sc.D., F.R.S.

(*Professor of Botany, University of Lucknow*)

IN a brief note published in May 1936 I described some Antiquities from the Khokra Kot mound at Rohtak in the Jumna valley.[1] The main subject of that note was the discovery of one of the mint-sites of the Yaudheyas, and a description of the moulds in which some of the earliest coins of this famous warrior people were cast. Since then my interest in the technique of coining in Ancient India has led me, as far as time allowed, to collect all available references to ancient coin moulds found in India, with a view to write a detailed paper on the subject, which I hope to publish in the near future.

In this quest I have been fortunate enough to come across some data which seem to indicate that the ancient site at Sunet, near the modern town of Ludhiana in the Punjab, was another of the mint-places of the Yaudheyas. At this place were cast some of the later Yaudheya coins, namely, those bearing on the obverse the figure of Kārttikeya holding a spear and the Brāhmī legend

Yaudheyagaṇa-
sya jaya

and on the reverse a human figure with one arm upraised, the other held on the hip, with a ring of dots round the margin of the coin (see Figs. 1, 2). This is a well-known copper coin which I think was first figured by Prinsep[2] in 1835 and later by several others. This coin is generally assigned to the third–fourth century A.D.; in any case it is distinctly later than the coins cast in the Rohtak moulds described by me in 1936.

My evidence for regarding Sunet as a probable mint-town of the later Yaudheyas is the fact that here a considerable number of clay moulds of the type of coin just described have been found from time to time during the last fifty-six years: although, strangely enough, the real nature of these finds has so long remained obscure.

In 1884 Dr. A. F. R. Hoernle[3] exhibited before the Asiatic Society of Bengal a number of clay objects from Sunait (Sunet), all of which he referred to as "seals". Unfortunately none of these specimens were ever figured, but among them were three specimens which are of special interest to us here, and of these, luckily, Hoernle gave a very clear and detailed description, showing that they bore the obverse and reverse designs of the Yaudheya coin above mentioned. Two of them bore the reverse design and one the obverse; the impression in each case was in the negative.

Hoernle was evidently puzzled as to the purpose for which these "three exceptional seals" might have been employed; and somehow it did not occur to him that they were coin moulds. He believed that the designs must have been made by pressing actual coins into the clay before it was baked, and this may well have been the case, because coins have commonly been used as models for moulds. But in discussing the purpose for which these so-called seals were used he offered a conjecture which appeared to me needlessly far-fetched. He suggested that they may have been made by the poorer pilgrims as a cheap sort of votive tablets to escape payment for the more expensive properly stamped tablets supplied by the temple authorities. As we shall see, these supposed seals or votive tablets of Dr. Hoernle were in reality coin moulds of the Yaudheyas. In fact they were, so far as I know at present, the first coin moulds of Ancient India ever to be described.

Hoernle's originals, as stated, were exhibited before the Asiatic Society at Calcutta. Hoping that they might still be preserved at the Indian Museum I was trying to obtain a loan of them when, through a remarkable coincidence, I received in November last, from a totally unexpected quarter (namely the Bhārat Kalā Bhawan at Benares), a collection of no less than 38 clay moulds

[1] Sahni, *Curr. Sci.*, 1936, **4**, No. 11, 796–801.

[2] Prinsep, *Jour. As. Soc. Bengal*, 1835, **4**, 621–43.

[3] Hoernle, *Proc. As. Soc. Bengal.*, 1884, **53**, 137–40.

answering so exactly to the description given by Hoernle that there can be no doubt they were of the same nature. These 38 moulds also came from Sunet, but they had been discovered only within the last couple of years. Twenty-five of them had been purchased by the distinguished historian Prof. Jaya Chandra Vidyalankar at the modern village of Sunet on September 13, 1938, and the rest were similarly acquired on the spot by his pupil Mr. Amrit Pal on August 8, 1940. All these specimens are now in the Bhārat Kalā Bhawan (Museum of Indian Art and Archæology) at Benares, and I owe it to the generosity of my friend Rai Krishnadasa, founder and director of the Kalā Bhawan, and to the kind offices of Prof. Jaya Chandra, that I am here able to describe some of these interesting finds (see Figs. 3–6). I ought to add that before I had seen the Benares specimens Rai Krishnadasa was already sure that these objects were coin moulds. In fact he originally had the intention to describe them himself. That he so readily placed his material at my disposal is characteristic of him.

That the figured specimens can only be coin moulds and not seals is evident from the following facts: (*a*) There is a channel for the inflow of molten metal across the margin, clearly seen in several of the more complete specimens. (*b*) One specimen consists of two pieces still coupled together, with the remains of a clay plaster casing adhering round their outer margins, showing that the moulds were cast in a series of discs which were plastered together into a cylindrical pile. (*c*) The raised margin immediately round each coin socket has a rough, fractured surface, showing that two coupled moulds have been broken apart. (*d*) The back of each disc also has a rough, fractured surface. It is neither smooth and domed, as in many true seals, nor is it formed into a ridge to enable it to be held between the thumb and finger; nor, again, are there any string holes in any of the specimens. In most cases the back has a rough surface, suggesting that the discs were originally coupled together and were later split apart when the mould was broken up for taking out the coins.

These undoubted coin moulds from the Kalā Bhawan's collection had already convinced me that Hoernle's specimens (which I was still hoping to obtain from Calcutta) must be of the same nature. It was therefore no surprise to me when on January 10, 1941, I received through the kindness of Mr. T. N. Ramachandran, Superintendent of the Archæological Section at the Indian Museum, a number of specimens showing identically the same features as those just described. The Indian Museum moulds are in a better state of preservation; several of these are figured here for comparison with those from the Kalā Bhawan (see Figs. 7–12).

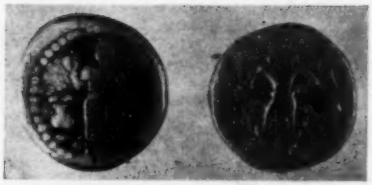
This collection from Calcutta, however, brought me a real surprise in another way. It was not the mere three specimens described by Hoernle in 1884 that Mr. Ramachandran had sent in response to my request, but a handsome series of as many as 41 coin moulds. Whether Hoernle's originals are amongst them it is not possible for me to say, because these were never figured, and there are no other indications to identify them. But after what I have said above there can be no doubt that Hoernle's pieces were of the same nature and date as those brought to light by Professor Jaya Chandra over half a century later. What is more, the fact that instead of Hoernle's three specimens so many more have now turned up from the Calcutta Museum shows that after the original find at Sunet a number of further moulds were discovered at the same locality, at a date or dates of which at present I have no information.

The suggestion is therefore not unjustified that at Sunet there must still be many more coin moulds of the same type, waiting to be unearthed, and that quite probably this modern village marks the site of a regular mint of the later Yaudheyas. A systematic enquiry on the spot, and a trial excavation of the area from where these moulds were obtained as surface finds, thus promises to be of considerable interest.

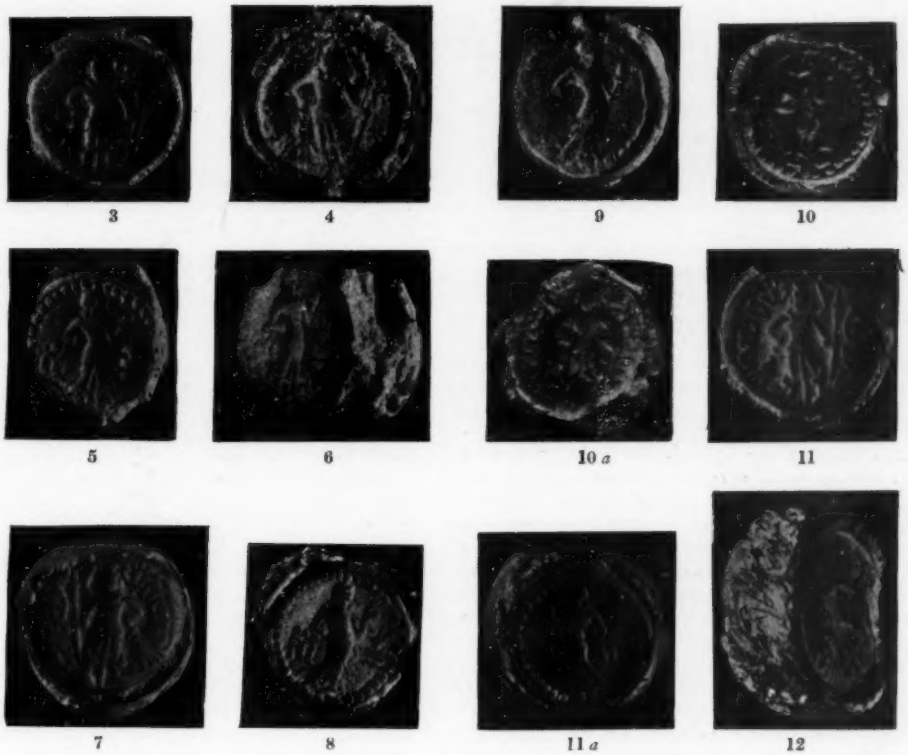
In the end, I have pleasure in expressing my sincere thanks to my assistant, Mr. R. V. Sitholey, M.Sc., who has kindly prepared all the photographs.

Postscript added 30th January 1941.—

Mr. V. S. Agrawala, M.A., Curator of the Provincial Museum, Lucknow (who has kindly read the above paper in MS.) has been able to identify the ancient name of Sunet. He writes (Jan. 25): "In the Saṁkalādi group of the sūtra IV.2.75 Paṇini, the



1 2



3 4 9 10

5 6 10 *a* 11

7 8 11 *a* 12

Figs. 1, 2. Reverse and obverse of two coins kindly lent by Mr. Jai Krishna Agrawal of Lucknow. Nat. size.

Figs. 3–6, Moulds from the Bhārat Kalā Bhawan (Benares). 3 shows a groove for the inflow of metal across the top left margin, 4 across the bottom margin; both are negatives of the obverse face. 5 and 6 show the negative of the reverse face. 6 is a double mould photographed obliquely to show the two coupled discs; the lower disc bears on its exposed face which is turned away from view a negative of the obverse. The registered numbers of the Kalā Bhawan's collection are as follows: Fig. 3 = 97·269; Fig. 4 = 97·272; Fig. 5 = 97·260; Fig. 6 = 97·266. All nat. size.

Figs. 7–12. Moulds from the Indian Museum (Calcutta). 7–10 show grooves for the inflow of metal across the top margin (7) or across the right margin (8–10). 7 and 8 are plain reverse impressions, without the objects shown in front and behind the standing figure in 11. 10 *a* and 11 *a* are positives made in plasticine from 10 and 11. 12 is a double mould photographed obliquely to show the cylinder of plaster (clay mixed with fibrous vegetable matter) round the coupled discs; the hidden lower disc shows on its exposed face not in view a negative of the reverse. Registered numbers, 7 = 9162; 8 = 9165; 9 = 9199; 10 = 9195; 11 = 9183; 12 = 9202. All nat. size.

great grammarian, reads Sunetra in a geographical context. The place founded by Sunetra would be called Saunetra and this seems the ancient name of this place ..... Sunetra according to the Mahābhārata (Ādiparva 94.61) was one of the three sons of the elder Dhṛitarāshṭra ..... The name of the Yaudheya republic occurs in Panini's Ashṭādhyāyī and it is appropriate that he was also acquainted with the name of one of their important towns. This reference takes back the antiquity of Sunet to about 500 B.C., which point commends it as a very suitable place for further exploration".

I am grateful to Mr. Agrawala for permission to quote from his letter to me.

ALL-INDIA SOIL SURVEY

BY

B. VISWA NATH

(Imperial Agricultural Research Institute, New Delhi)

THE subject of All-India Soil Survey, the carrying out of which has been approved by the Imperial Council of Agricultural Research, has been under discussion in recent years.

There had been considerable expansion in the activities of Agricultural Departments of late, and with the increase in the amount of work done on soils and crops, the need for more information was felt. The subject came up for discussion by the Crops and Soils Wing of the Board of Agriculture in India, in the years 1935 and 1937 and the Board recommended that steps should be taken to carry out a soil survey of India. Following this recommendation, the Imperial Council of Agricultural Research appointed in May 1939 an *ad hoc* Committee of Soil Chemists, to make recommendations for carrying out the soil survey. This Committee reported that a large amount of published and unpublished data on soils accumulated by Agricultural Departments, and considerable useful information on soil survey and classification as adopted by Revenue Departments, were already available in the country, that soil surveys had either been carried out or had been in progress in several parts of India and that, therefore, the first requirement would be the collection and critical examination of all available data. For this purpose the Committee recommended the appointment of a standing Soil Survey Committee and the requisite staff for the collection of the existing data and for its collation and preparation for further consideration by the Soil Survey Committee. The Advisory Board and the Governing Body of the Imperial Council of Agricultural Research approved in principle the report of the *ad hoc* Committee, and it is understood that steps are being taken to implement the recommendations. This may, at first sight, appear to be an unnecessarily slow procedure but it will be realised that it is not only a sound step forward but is one calculated to expedite the survey, because it will enable the adequate appreciation of the nature of work to be done, having regard to Indian systems and conditions and of the initial difficulties to be overcome.

The problem of soil survey and soil classification in India is unique, in that it has to blend the existing classification which is in many ways sound with the modern scientific system. Soil survey and soil classification in theory and practice are not unknown to India and to some eastern countries. It is on record that the Chinese carried out a soil survey, under the orders of the Emperor of the *Yao* dynasty between the years 2357 B.C. to 2261 B.C. In India, ideas on soil classification and on crops in relation to soils appeared to exist even as early as 3,000 B.C., according to references in the *Vedas* and in the *Mahabharatha*. Kautilya's *Artha Shastra* and Abul Fazal's *Aini Akbari* provide evidence of intimate knowledge of soil classification by itself and in relation to crops, during the Hindu and Moghul periods. In this system of classification, which forms the basis of classification now current in India for land valuation and assessment, depth, colour and consistency were important considerations which closely approximate modern concepts on the subject. In most provinces in India, each village has its map showing the nature and extent of agricultural lands and areas and in addition there are available, topographic sheets for different areas published at

Calcutta by the Survey Department of the Government of India.

Leather, who was Agricultural Chemist to the Government of India, was the first in India to carry out, about forty years ago, a soil survey on scientific lines. It was a broad and comparative survey giving the composition of the well-known major soil types and his publication, in the series of Agricultural Ledgers, was in the early years a very useful source of information on Indian soils. Even in those days, Leather recorded results of examination of sections of soils and the depth disposition and composition of the soil layers which in modern terminology are called profile and horizon studies. The province of Madras was the first to undertake in 1912 systematic soil surveys and to present the data in the form of soil survey maps. The Punjab commenced surveys in 1919, and other Provinces and States soon followed. So far as is known soil surveys were completed and/or have been in progress for large tracts in the Provinces of Madras, Bombay, Bengal, the Punjab, Sind, Assam, United Provinces, Bihar, and in the States of Mysore, Travancore, Hyderabad and Limbdi. The plan and extent of the survey, as would be expected, varied in accordance with the resources and the emphasis laid on the needs and problems.

The Royal Commission on Agriculture in India examined the question fifteen years ago. Although they recognised the value of a soil survey to agriculture, they could not recommend it for two reasons. Firstly it would be very expensive, and secondly the main classes of soils and their approximate locations were known, already, and surveys were actually in progress in some provinces. They had evidently the Russian and American soil surveys in view and rightly considered that the advantages to be gained by such surveys in this country would not be commensurate with the time, labour and expense involved. The Royal Commission, however, recommended surveys of limited areas for specific purposes, such as irrigation projects.

We have thus, on the one hand, established systems of agriculture and working knowledge of soils handed down through generations of experience to the cultivator, who, if he were independent of considerations of cost, could use his art to obtain the maximum possible returns from his soils; and on the other hand, there are available accurate village maps and topographical sheets besides the empirical data available with the Revenue and Settlement Departments and the scientific data that are available with the Agricultural, and related Scientific Departments. It is true that the available scientific data were obtained in the course of routine analytical and advisory work of the Agricultural Chemists and that most of the data were obtained under the older concepts of soil analysis and by the employment of older methods which are incapable of being brought into line with modern views and methods of soil science. That should not, however, be a serious argument for rejecting the existing data without careful examination and for starting with a clean slate. For, it would raise the obvious question, whether a classification once made can or cannot be permanent over a reasonably long period and will be liable to revision, at short intervals and if the answer is that it cannot be permanent, the case for a soil survey fails. Compared to those of the temperate regions of Europe and to the comparatively recent agricultural soils of America, Indian soils have reached a state of maturity to be hardly met with in those countries. The soils in India, may in most cases be considered to have undergone almost permanent changes and adjustments in regard to their evolution processes and their relation to agricultural practices and crop production is influenced principally by water and drainage facilities and state of fertility.

The records and data that are available with the Land Records and Settlement Departments may not be found suitable for preparing soil maps on modern lines but they are likely to afford useful information on a wide basis and will certainly be valuable in giving information for check on the geographical distribution of the major soil types or zones and will also be useful in securing correlation of the modern systems and nomenclature with the local descriptive names used by the cultivators in different parts of the country and which the Land Records and Settlement Departments employ.

The ultimate object of survey is to assess soil capacity as a potent factor in the agro-industrial economy of the country. It is a part of national service to the agriculturist.

There can be two classes of soil survey. One relates to the division of soils into broad groups; the other relates to surveys of local areas. The first one has for its object the projection of important relationships which may admit correlations with the behaviour of soils in localised areas. The second is concerned with individual local areas, farms or fields. The normal procedure is to carry out the first kind of survey and then to apply the knowledge obtained from the study of broad groups in surveys of similar soils and conditions in localised areas. As it is, the position is different. We have data on the second type of local surveys. Information on broad groups is lacking. This deficiency can be partly made up by the soil studies that are now in progress at the Imperial Agricultural Research Institute. It will not be a substitute for the proposed All-India Survey but will provide useful information in the interpretation of the collected data. The work that has been in progress at the Institute is the comparative study of soils and their profiles from different parts of India, to secure a general picture of the evolutionary status of soils under varied geological and climatic influences, and for defining broad soil groups in relation to the world scheme of soil classification and in relation to cultural and fertiliser practices.

The principal aim of the preliminary work of collection and collation of data is, therefore, to bring out the more important facts from the work of the past thirty or forty years and to bring them together and then to ascertain where and what the gaps are and to determine the means of filling them. Such an assessment of the existing data will also be in the nature of preparatory work for the soil survey. It will help in knowing the problems and difficulties. As an instance in point may be mentioned the problem of textural classification in the field. Formulæ for correlating laboratory data on mechanical analysis with field behaviour have to be devised and these should be such as would agree with the local definitions of the cultivator. Field workers should be trained in naming textural classification in a manner that it correlates with that of other workers in different units in the same area and with that of workers working independently at a distance. Such are the problems to be faced and solved before the soil survey is commenced and the study of the existing data in their relation to agronomic practices should be of inestimable value as the first step in carrying out the survey.

THE FIRST ALL-INDIA PHARMACEUTICAL CONFERENCE

THE first session of the All-India Pharmaceutical Conference was held in the Benares Hindu University on the 3rd and 4th of January 1941, Mr. S. N. Bal, PH.C., M.S., Curator, Industrial Section, Indian Museum, presiding. Prominent scientists and representatives of pharmaceutical concerns from all over India attended the session.

Sir Sarvapalli Radhakrishnan, inaugurating the Conference, said that along with the social and political awakening in our country we are passing through a phase of industrial renaissance. He observed that India hitherto used to export raw materials and import manufactured drugs resulting in a great loss to the country's wealth.

In the course of his Presidential Address Mr. S. N. Bal traced the growth and development of pharmacy in the world in general and in India in particular. He deplored the serious lack of facilities for pharmaceutical education in this country, and emphasised the importance of pharmacognosy particularly to a country like India which abounds in plants of great medicinal value. Though in recent years isolated workers in different universities and medical institutions have done valuable work on certain drugs, it is still far from adequate. Amateur collectors of crude drugs bring into the market unsatisfactory plant materials, and there is an imperative necessity for a botanical garden of medicinal plants and

a herbarium. In conclusion he referred to the recent legislation to regulate the sale and manufacture of drugs but it is only when all the interested persons co-operate and the public keep a vigilant eye that the object of the Act can be realised.

Resolutions, passed at the session, refer to the recognition of the profession of pharmacy in India, drafting of a Pharmacy Bill, the compilation of an Indian Pharmacopœia, the organisation of pharmaceutical research and the control of false and misleading advertisements of medicaments.

Besides a number of scientific papers read, two symposia were held, the first of which was on the organisation of the chemical and pharmaceutical profession in India with Prof. J. C. Ghosh, Director, Indian Institute of Science, as Chairman, and the second was on the manufacture of drugs from indigenous resources with Prof. T. R. Seshadri of the Andhra University as Chairman. In the course of his address Prof. Ghosh remarked, "The war is an ill wind, but it has blown at least one good thing—the public are now keenly anxious for the proper development of a pharmaceutical industry and the proper organisation of pharmaceutical studies in the country. In olden days the apothecary used to make in a shop all the pills, tinctures and extracts which the physicians prescribed, but the base of most of these pharmaceutical operations has now been transferred from the apothecary's stores to the factory of the drug manufacturer; it is here that the chemist and the pharmacist meet." He then referred to the Drugs Act and the proposed Pharmacy Act and pointed out how they would create a continual demand for highly trained pharmaceutical chemists.

In the discussion that followed, the need for safeguarding the interests of the chemical and pharmaceutical profession and for the recognition of the primary importance of the chemist in drug and food control and standardisation of laboratories was emphasised. Unfortunately there has been a tendency to over-emphasise the place of pharmacology in the analytical laboratories of our country. The formation of a permanent committee on the lines of the *Chemical Council of Great Britain* was suggested.

Introducing the symposium on the manufacture of drugs from indigenous sources, Prof. Seshadri pointed out that though the present time may be said to be the most propitious for the rapid development of a drug industry in India, the response from industrialists including capitalists and technologists has been comparatively poor. A guarantee that the present demand by the Government and the public for drugs manufactured in India will continue and that legitimate protection against outside competition will be given after the war, is needed for providing the necessary stimulus for large-scale drug production in the country. A protected drug supply is as important to the health of a community as a protected water or food supply. No famine in these essential requisites or blockades can be allowed. He then discussed how the Government, the industrialists, the scientists, the universities, the politicians and the public can play their part for the rapid development of the drug industry.

During the discussion, a review of the present achievements in drug manufacture and drug control in India was made, attention being drawn to the excise difficulties and heavy freight charges and certain inconvenient regulations in the supply of some raw materials and to the need for greater attention for the fabrication of manufacturing units.

LETTERS TO THE EDITOR

INTERACTION OF ATOMIC ENERGY LEVELS

The present investigation is a continuation of the work we have already reported,[1] undertaken with a view to obtain information regarding the mutual influence of atomic energy states. The general method is to excite the spectra of two elements and then the spectrum of their mixture, all under identical conditions; a comparison of the relative intensities of the lines in the spectra of the individual elements with the relative intensities of the same lines in the spectrum of the mixture gives the required information.

Winans and Williams[2] have compared the relative intensities of tin lines obtained from a carbon arc containing tin with those from a Tesla discharge through a tube containing tin and mercury, when the latter was irradiated by λ2537 of Hg. The dispersion used by them was very small. In our experiments the spectra of the individual elements and of their mixture have been obtained under similar conditions for all, and the dispersion employed is quite large.

Results

The lines of tin and mercury that suffered modification in intensity by mixture are given below:—

Tin Lines

Strengthened:

2839·99	$5p^2\ {}^3P_2 - 5p6s\ {}^3P_2^\circ$
2850·61	$5p^2\ {}^1D_2 - 5p5d\ 1_2^\circ$
3034·12	$5p^2\ {}^3P_1 - 5p6s\ {}^3P_0^\circ$
3175·04	$5p^2\ {}^3P_2 - 5p6s\ {}^3P_1^\circ$
3262·33	$5p^2\ {}^1D_2 - 5p6s\ {}^1P_1^\circ$

Weakened:

2317·21	$5p^2\ {}^1D_2 - 5p6d\ 4_3^\circ$
2334·80	$5p^2\ {}^3P_1 - 5p5d\ 3_1^\circ$
2354·84	$5p^2\ {}^3P_1 - 5p5d\ 2_2^\circ$
2421·69	$5p^2\ {}^1D_2 - 5p5d\ 11_3^\circ$
2429·49	$5p^2\ {}^3P_2 - 5p5d\ 4_3^\circ$
2483·5	Sn II.
2495·72	$5p^2\ {}^1D_2 - 5p5d\ 9_2^\circ$
2546·55	$5p^2\ {}^3P_0 - 5p6s\ {}^1P_1^\circ$
2571·60	$5p^2\ {}^1D_2 - 5p6d\ 6_2^\circ$
2594·43	$5p^2\ {}^1D_2 - 5p6d\ 5_2^\circ$
2661·25	$5p^2\ {}^3P_1 - 5p6s\ {}^1P_1^\circ$
4524·74	$5p^2\ {}^1S_0 - 5p6s\ {}^1P_1^\circ$

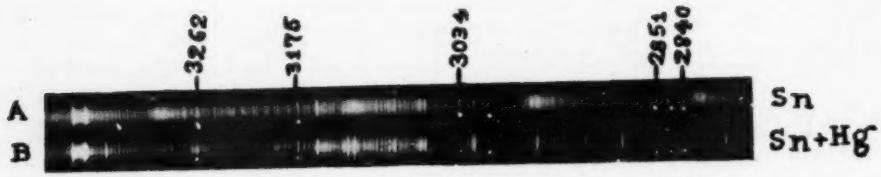


FIG. 1

A—Tin
B—Tin and Mercury Mixture

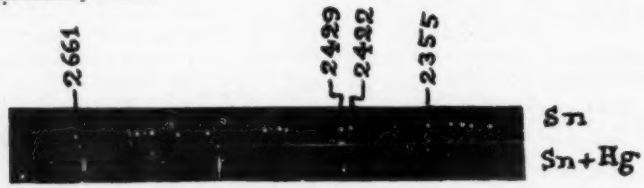


FIG. 2

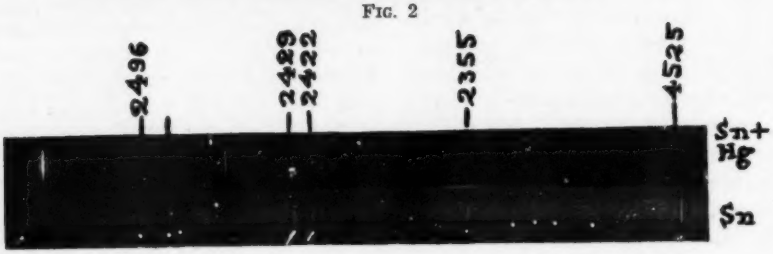


FIG. 3

FIG. 4

FIG. 5

FIG. 6

MERCURY LINES

Strengthened:

2464·02	$6^3P_0 - 9^3S_1$
2536·52	$6^1S_0 - 6^3P_1$
2652·04	$6^3P_1 - 7^3D_2$
2653·68	$6^3P_1 - 7^3D_1$
2655·13	$6^3P_1 - 7^1D_2$
2752·77	$6^3P_0 - 8^3S_1$
2856·94	$6^3P_1 - 8^1S_0$
2893·62	$6^3P_1 - 8^3S_1$
2925·41	$6^3P_2 - 9^3S_1$
2967·28	$6^3P_0 - 6^3D_1$
3983·96	Hg II
4077·83	$6^3P_1 - 7^1S_0$
4108·08	$6^1P_1 - 9^1S_0$

Weakened:

2400·52	$6^3P_1 - 9^1D_2$
2639·93	$6^3P_2 - 10^3D_3$
2698·85	$6^3P_2 - 9^3D_{2,3}$
3704·25	$6^1P_1 - 9^1D_2$

DISCUSSION

In considering the explanation for these facts we must take into account the processes that occur in the discharge tube. Mercury and tin atoms are being raised to excited levels by electron impacts and there are also impacts between normal and excited tin and mercury atoms. Of these impacts, those involving atoms in metastable states are of greater interest. Now mercury has two metastable levels at 37642·3 and 44040·2 cm.$^{-1}$ respectively above the ground state and tin has four such levels at 1692·0, 3428·0, 8613·5 and 17163·0 cm.$^{-1}$ respectively. Now all the tin lines that are strengthened have upper levels near the two metastable levels of mercury as can be seen from the previous table. Hence their strengthening must be explained as due to impacts of normal tin atoms with metastable mercury atoms in which the latter give their energy to the former. The brightening of the tin lines may also be due to impacts of normal tin atoms with mercury atoms in the $6\,^3P_1$ state, but this process does not seem to be very frequent since 2536 ($6\,^3P_1 - 6\,^1S_0$) is brightened instead of becoming weaker. This strengthening of 2536 must be due to increased production of the $6\,^3P_1$ state by impacts with tin atoms in the $5p6s\,^1P_1{}^\circ$ state. The energy of the latter state is very close to that required to excite $6\,^3P_1$ and two tin lines having that state as the upper level have become weaker. But 3262 of tin which involves the same upper level is brightened. This must be explained by the fact that for this line the transition probability being larger, the transition takes place before the energy of the upper state is destroyed by collisions. Taking the upper states of the other tin lines which have been weakened, we find that they have energies near 44000, 47000, 49000 and 52000 cm.$^{-1}$ The first of these may be used up in producing metastable mercury atoms in the $6\,^3P_2$ state. The other energies when added to the energies of the $6\,^3P_0$ metastable state of mercury amount to 82000, 85000, 87000 and 90000 cm.$^{-1}$ respectively and are quite sufficient to ionise the mercury atom (energy required for ionisation 84178·5 = cm.$^{-1}$). That such ionisation does take place seems to be corroborated by the strengthening of the mercury spark line 3984. The four lines of mercury which are weakened have upper states of energy about 81000 which when enriched by impacts with metastable tin atoms particularly in the $^3P_2$ state (3428 cm.$^{-1}$) will lead to the ionisation of the mercury atom. This serves to explain why the corresponding mercury lines are weakened. As for the mercury lines which are strengthened, we have already explained the strengthening of 2536. Taking the others we find the enriched upper levels having energies of 64000, 71000, 74000, 77000 and 78000 cm.$^{-1}$ respectively. These states must arise from mercury atoms taking up the requisite energy from tin atoms. The probable states can only be guessed. Mercury atoms in the $6\,^3P_2$ state taking the energy of the metastable $^1S_0$ state of tin lead to an energy equal to 61000 cm.$^{-1}$ The $6\,^3P_0$ state of mercury by taking the energy of tin atoms in the $^1P_1{}^\circ$ state can be raised to a level = 77000 cm.$^{-1}$ Mercury atoms in the $6\,^1P_1$ state can, by taking the energy of tin atoms in the metastable $^1D_2$

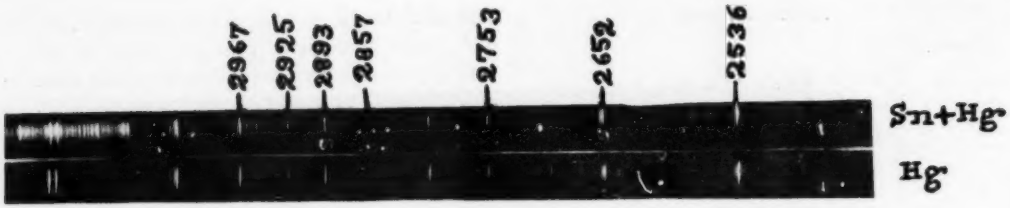


FIG. 7

FIG. 8

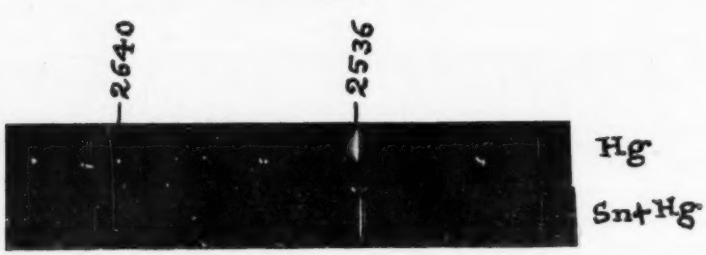


FIG. 9

state, be raised to 63000 cm.$^{-1}$ while, by taking energy from the metastable $^1S_0$ state of tin, they can be raised to 71000 cm.$^{-1}$ Whether these processes actually occur cannot be further corroborated by our experiments, since transitions from the $6\,^1P_1$ state are beyond the range of our instruments. Other mercury levels near 77000 cm.$^{-1}$ also do not give lines accessible to our observation. Some mercury lines such as 3663, 3654 and 3651 Å, as well as 5791, 5789 and 5770 Å do not show any appreciable change in intensity although their upper levels are near 71000 cm.$^{-1}$ Such preferential interaction of levels, leading to changes in the population of some levels and none in other levels very close to the first, occurs also in the other mixtures studied by us. The regularities underlying such preferential interaction can only be perceived when much more extensive data have been accumulated, but a tentative explanation may be offered by noting that the transition probabilities for the lines 3650, 3654, etc., are larger than those for 2967 and hence there is a greater chance for 2967 to be affected.

In conclusion, it is a pleasure to record our thanks to Professor A. Venkat Rao Telang for much encouragement and many facilities.

T. S. SUBBARAYA.
K. SESHADRI.
N. A. NARAYANA RAO.

Physics Department,
Central College,
Bangalore,
January 27, 1941.

[1] *Curr. Sci.*, 1939, **8**, 508; 1940, **9**, 14; 1940, **9**, 173.
[2] *Physical Review*, 1937, **52**, 930.

A NEW (2 → 2) BAND IN THE SPECTRUM OF THE *OD* MOLECULE

In an attempt to search for *OD* in the solar spectrum, photographs have been obtained of the band λ3065 and the adjacent regions with different exposures. The spectrum in this region consists of a number of overlapping bands which degrade to the red. The $\Delta v = 0$ sequence lies mostly in this region, the origin of the (0 → 0) band falling within a few wave numbers of that of the corresponding *OH* band. The high initial purity of the sample of heavy water produced a spectrum entirely free from any trace of *OH* bands. The method of excitation was similar to that described by Rao and Sastry[1] and the same spectrograph was employed for photographing the spectrum. With this type of discharge tube the background radiation was greatly reduced.

Precision measures of wave-lengths of about 200 lines in the region between λλ3100–3250 have been made. Among these are about 90 lines which form the six principal branches of a new (2 → 2) band. The relative intensities of the lines in the several branches of this band have been studied from microphotometric traces. The rotational term differences obtained from these branches are used to evaluate the molecular constants. The agreement between these and similar values derived by Rao and Sastry from the (2 → 1) and (3 → 2) bands justifies the quantum assignment.

A study of the lines of the (0 → 0), (1 → 1), and (2 → 2) bands for possible solar correlations has been made. A complete description of this work will be published shortly.

A. L. Narayan.

Solar Physics Observatory,
Kodaikanal,
January 1941.

[1] Rao and Sastry, *Curr. Sci.*, 1940, **9**, 225.

A NOTE ON COAGULATION OF COLLOIDS BY BI-METALLIC JUNCTIONS

When a potential is established colloid particles migrate and flocculate at the poles. Even a slight potential is considered sufficient. In the present experiments the effect of bi-metallic junctions on coagulation of colloids have been studied.

An iron-aluminium couple was prepared by dipping a freshly cleaned piece of aluminium foil in a warm concentrated solution of ferric chloride. An adherent deposit of iron on the aluminium surface was obtained if the replacement was not allowed to proceed too far. The couple was washed completely free from all adhering electrolytes and then introduced into an arsenic sulphide sol. A remarkably rapid coagulation of the sol was observed. The coagulation always proceeded from certain active points on the couple and soon definite streaks of coagulated particles became visible. In fact coagulation occurs most at the points where the active hydrogen is most vigorously evolved. A number of different colloidal solutions have been studied with various couples. Nearly all negatively charged sols are rapidly coagulated.

A detailed study has shown that the coagulation is not entirely due to the electrical potential. The experiments of Biltz[1] have been repeated and it has been found that definite quantities of metallic ions are generated by dissolution of the metal electrodes in the slightly acid medium of the sol. The flocculation of sols by couples, as described here, is largely due to electrolyte coagulation. During the coagulation of an arsenic sulphide sol by the iron-aluminium couple, definite tests for aluminium were obtained in the fluid of the colloid.

The peculiar feature of this method of coagulation, however, is that the disturbing influence of the conjugate ion which is unavoidable during electrolyte coagulation, is largely absent. This process thus affords a truer method of studying the Schultz-Hardy law for coagulation by metallic ions. A detailed report will be published soon.

P. B. Ganguly.

Physico-Chemical Laboratory,
Science College, Patna,
December 20, 1940.

[1] *Zeitt. Electrochem.*, 1908, **14**, 567.

MAGNETIC SUSCEPTIBILITY OF IODIC ACID IN AQ. SOLUTION (CONSTITUTION OF IODIC ACID)

IN a previous communication to *Current Science*[1] and in a detailed paper[2] it was pointed out that in the case of aqueous solutions of Iodic acid a number of properties, *e.g.*, density, viscosity, parachor, refractive index, temperature coefficient of conductivity, all showed a remarkable similarity in their curves which exhibited breaks at 0·04 N and 0·09 N.

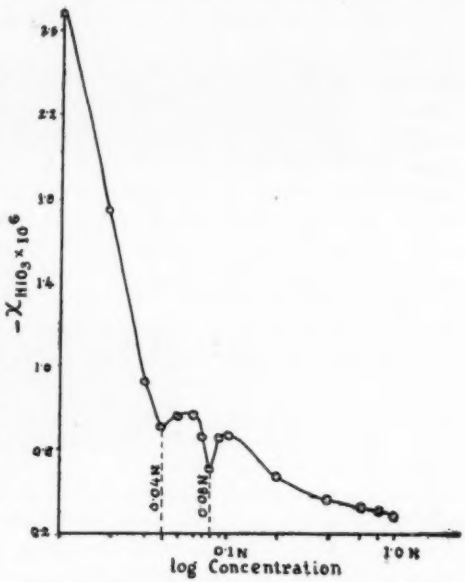
In the present investigation the magnetic susceptibility of the aqueous solution of the acid at different concentrations has been measured, and the mass susceptibility determined and plotted against concentration. The susceptibility measurements have been carried out previously by S. R. Rao and Sriraman[3] by means of a Curie balance at concentrations ranging from 17 per cent. to 76 per cent. from which they concluded that "no systematic variation was obtained when the concentration was varied". In our case we used a modified form of Decker's balance with a special device for temperature control. The region of concentration investigated was between 0·01 N and 1·0 N, that is, below that of the previous workers. The following formulæ were used to evaluate firstly the susceptibility of the solution, and from that the mass susceptibility of the solute:—

$$(1)\quad \chi_{sol}\cdot\rho_{sol} = \chi_w\cdot\rho_w + (\chi_w\cdot\rho_w - \chi_a\rho_a)\cdot\frac{\theta_w-\theta_{sol}}{\theta_a-\theta_w}$$

$$(2)\quad \chi_{sol} = C_s\cdot\chi_s + (1-C_s)\chi_w$$

where χ_{sol}, χ_w, χ_a are the susceptibilities of the solution, water and air, ρ_{sol}, ρ_w, ρ_a are the densities of the solution concerned, water and air, and θ_{sol}, θ_w, θ_a are the deflections for solution, water and air respectively, and in the second equation C_s is the concentration, χ_s the mass susceptibility of the solute, and χ_w the mass susceptibility of water.

It will be observed that the curve shows two breaks at 0·04 N and 0·08 N. These correspond remarkably well with similar breaks in the curves obtained with other properties and were explained as due to transition points arising



from the polymerisation of Iodic acid according to the scheme:

$$HIO_3 \rightleftarrows \tfrac{1}{2}(HIO_3)_2 \rightleftarrows \tfrac{1}{3}(HIO_3)_3.$$

The detailed paper will appear elsewhere. Our thanks are due to Dr. K. N. Mathur for the construction of the magnetic balance which is of remarkable sensitivity.

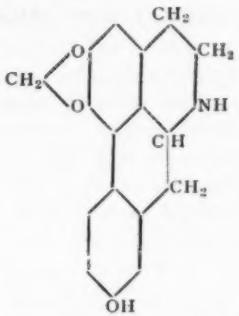
M. R. NAYAR.
N. K. MUNDLE.

Lucknow University,
December 26, 1940.

[1] *Curr. Sci.*, 1939, **8**, 73.
[2] M. R. Nayar Srivastava, Sen, Ramgopal & Sharma, *Z. anorg. u. allg. Chem.*, 1939, **240**, 217.
[3] *Phil. Mag.*, 1937, **24**, 1030.

SYNTHESIS OF *dl*, ANALOBINE-*O*-METHYL ETHER (*dl*-2, METHOXY-5, 6 METHYLENE DIOXY-NOR-APORPHINE)

ANALOBINE, an alkaloid obtained from *Asimina triloba* was assigned the following constitution by Manske[1] on the basis of analytical data:



1-2, hydroxy-5, 6-methylene dioxy noraporphine

Its synthesis was undertaken not only because it was felt that a rigid proof of its structure was desirable but also because of the great interest attached to phenolic aporphines. It was proposed to synthesise 2, benzyloxy-5, 6-methylene dioxy noraporphine, and after debenzylation resolve the inactive phenolic aporphine into the active forms. This procedure would eliminate the complications that would ensue with a free hydroxyl group at the isoquinoline ring closure stage.[2,3,4]

The starting materials were Homopiperonylamine[5] and 2, nitro-5, benzyloxy-phenyl acetic acid. The acid could not be prepared in good yield by the method of Perkin for 2, nitro-5, methoxy-phenyl acetic acid[6] because the yield of the intermediate 2, nitro-5, benzyloxy-phenyl pyruvic acid by condensation of 2, nitro-5, benzyloxy-toluene with ethyl oxalate was poor. It could, however, be prepared in good yield on the lines of the method of Gulland, Ross and Smellie[2] for 2, nitro-4, hydroxy-3, methoxy-phenyl acetic acid. *m* aldehydo-*p* nitro phenyl carbonate[7] with hippuric acid and acetic anhydride gave the azlactone (m.p. 162°) of 2, nitro-5, hydroxy-benzaldehyde. This, with alcoholic HCl under pressure at 100°, gave 2, nitro-5, hydroxy-phenyl pyruvic acid (m.p. 194°, 70 per cent.) which was then oxidised with H_2O_2 to 2, nitro-5, hydroxy-phenyl acetic acid (m.p. 199°, 90 per cent.), and benzylated to 2, nitro-5, benzyloxy-phenyl acetic acid (m.p. 165°, 80 per cent.). The acid chloride prepared by the action of thionyl chloride, on addition to homopiperonylamine gave the amide (m.p. 145°–146°) in good yield. This was converted to 2′, nitro-5′, benzyloxy-1, benzyl-3, 4-dihydro-6, 7-methylene dioxy-isoquinoline in 80 per cent. yield by PCl_5 in $CHCl_3$ at room temperature for 7 days (Picrate, m.p. 190[6]–191°). On reduction with Zn and HCl (d, 1·16) at 100°, the benzyloxy group was not disturbed, and 2′, amino-5′, benzyloxy-1, benzyl-1, 2, 3, 4-tetrahydro-6, 7-methylene dioxy-isoquinoline was obtained. This was extremely unstable in air. Picrate, m.p. 159°. Further work is in progress on the ring closure to the phenanthrene derivative.

Meanwhile the synthesis has been achieved of *dl*-2,methoxy-5, 6-methylene dioxy nor-aporphine starting from homopiperonylamine, and 2, nitro-5, methoxy-phenyl acetic acid. The amide (m.p. 182°–183°) was converted by PCl_5 and $CHCl_3$ at room temperature for 48 hours in 70 per cent. yield to the dihydro isoquinoline derivative (m.p. 166°–167°, Picrate m.p. 218°), and reduced to the amino tetrahydro isoquinoline derivative in 80 per cent. yield (hydrobromide, m.p. 244°). Diazotisation followed by boiling in methanol gave *dl*-2, methoxy-5, 6-methylene dioxy-nor-aporphine in 10 per cent. yield (B. hydrochloride—m.p. 305° from alcohol B.HCl. H_2O from water, m.p. 278°). It is proposed to resolve it into the active forms and compare the *l* form with Artabotrinine[7] and also Analobine O methyl ether.[1] Failing a resolution, the product obtained by a Gadamer ring cleavage on the synthetic aporphine will be compared with those obtained by a similar process on the natural alkaloids. Dr. Manske and the Institute of Medicinal Chemistry (where the late Dr. Barger worked) have been written to for specimens of the alkaloids for comparison. My grateful thanks are due to Prof. Dey for his valuable help and guidance in this investigation.

T. R. GOVINDACHARI.

Presidency College,
Madras,
January 1, 1941.

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1 *Can. J. Res.*, 1938, **16**, 76.
2 Gulland, Ross and Smellie, *J.C.S.*, 1931, 2885.
3 Douglas and Gulland, *ibid.*, 2893.
4 Kondo and Ishiwata, *Ber.*, **64**, 1533.
5 Buck and Perkin, *J.C.S.*, 1924, 1693.
6 *J.C.S.*, 1924, 296.
7 Mason, *J.C.S.*, 1925, 1196.
8 Barger and Sargent, *J.C.S.*, 1939, 991.

ALLEGED DIMERIC CONSTITUTION OF ETHYLENE DIAMINO CUPRIC CHLORIDE

CUPRIC CHLORIDE is known to give with ethylene diamine three types of salts to which the formulæ Cu en cl_2, Cu en_2 Cl_2 and Cu en_3 Cl_2 are usually given. In a recent paper[1] F. N. Chattaway and H. D. K. Drew observe that the supposed ethylene diamino cupric chloride Cu en Cl_2 is in reality a dimeric substance *bis*ethylene diamino cupric cuprichloride [Cu en_2] Cu Cl_4. The proof given for the dimeric structure is that it forms, according to their observation, the copper compound [Cu en_2] Pt Cl_4 with an aqueous solution of potassium chloroplantinite. The reaction has been supposed to take place in the following manner:

$$[Cu\ en_2]Cu\ Cl_4 \xrightarrow{K_2\ Pt\ Cl_4} [Cu\ en_2]Pt\ Cl_4 + K_2\ Cu\ Cl_4$$

Grienberg previously prepared this chloroplatinite from Cu en_2 Cl_2 and potassium chloroplatinite and described it as a violet red substance. Chattaway and Drew on the other hand observe it to be lilac pink in colour. The latter investigators represent the yellow substance obtained by Grossmann by the action of hydrochloric acid on ethylene diamino cupric chloride by the formula [en H_2] Cu Cl_4. They also attribute a dimeric constitution to the isobutylene analogue of the supposed *bis*-ethylene diamino cupric cuprichloride.

The present author first tried to find out whether propylene diamino cupric chloride obtained as a greenish blue precipitate from a molecular proportion of aqueous cupric chloride dihydrate and a molecule of propylene diamine, could be given the dimeric formula [Cu pn_2] Cu Cl_4. The monohydrate (m.p. 120°) dissolved in water and with hydrochloric acid gave the double chloride Cu pn H_2 Cl_4. It did not however form the chloroplatinite [Cu pn_2] Pt Cl_4 which was readily obtained from the deep purple aqueous solution of *bis*-propylene diamino cupric chloride Cu pn_2 Cl_2 and potassium chloroplantinite. The chloroplatinite [Cu pn_2] Pt Cl_4 was lilac pink and was also easily formed by the unstable *tris*-salt evidently by its decomposition to the *bis*-salt. It was noted that with excess of Cu Cl_2, the chloroplatinite of *bis*-propylene diamino cupric chloride yielded a greenish product, apparently the same substance which was produced by the action of potassium chloroplatinite on propylene diamino cupric chloride. It was difficult to separate the green substance from solution by filtration. Whether it is propylene diamino cupric chloroplatinite [Cu pn] Pt Cl_4 or not has yet to be ascertained. It may also be mentioned that ammonium chloroplatinate which is sparingly soluble in water readily formed a violet red chloroplatinate [Cu pn_2] Pt Cl_6 both from *bis* and *tris* propylene diamine salts of cupric chloride but not from the product obtained by mixing equimolecular proportions of cupric chloride and the diamine. The lilac pink chloroplatinite and the violet red chloroplatinate are precipitated only when there is more than a molecular proportion of propylene diamine for a molecule of the copper salt. Having failed to obtain any proof of the diameric structure in case of propylene diamino cupric chloride, experiments were performed with ethylene diamino cupric chloride. But the results obtained were exactly similar to the above. The present author therefore does not think that there is sufficient reason for giving a dimeric formula to ethylene diamino cupric chloride. It may simply be represented as the mono compound Cu en Cl_2.

KANAI LAL MANDAL.

Chemical Laboratory,
Presidency College,
Calcutta,
January 11, 1941.

[1] *J. Chem. Soc.*, 1937, 947.

TWO NEW GENES FOR COROLLA COLOUR IN *CICER ARIETINUM* L.

AN extensive survey of morphological variability in *Cicer arietinum* L., has shown the occurrence of plants with various coloured petals. These are usually found to be white,

greenish-white, blue and pink.[1,2] Variations among the pink types have also been noted.[2] The genic analysis of petal colours in gram, however, has so far revealed only the presence of four genes, W, B, P and C.[3,4,5] According to Ayyar and Balsubramaniam,[5] the genes B and C are complementary and produce blue colour in petals. In the presence of C, the gene P converts blue to pink, thus it is considered as a supplementary gene. White petals result in the absence of any one of the three genes either alone or in combination except when B and C are together. The gene W suppresses greenness changing greenish-white standard to white. Its relation to other genes is not known.[3]

While working for the genetic improvement of gram in Bombay the writers have found in local material pink and white flowered plants. So far neither local nor hybridized material in gram with us has shown the presence of blue-flowered plants. We have, however, found two distinctly new petal colour types which do not seem to have been reported so far. One of them has light salmon coloured petals and is easily distinguishable from the normal pink type. This type originates from a solitary plant discovered in a field of local gram at the Cereal Breeding Station, Niphad, in the year 1932. The other type has very light purplish petals but dark purple veins. This was discovered in a local sample obtained from Chikodi, Belgaum District, and grown at Niphad in the season of 1936.

Crosses of the salmon type with a normal pink type, showed the dominance of the latter in the F_1 and a monogenic segregation in the F_2 (57 pink : 19 salmon). When crossed with a white-grained and white-flowered type the F_1 showed pink flowers, and in F_2 a ratio of 9 pink : 3 salmon : 4 white flowers (actual numbers 45 : 13 : 19) was obtained. The F_3 confirmed the F_2 behaviour. We may, therefore, consider the salmon type to be due to a distinct gene. We propose to designate this gene as Sa.

Only one cross involving the purple-veined type is available. This consists of a white-flowered and yellow grained type. The F_1 was purple-veined and in F_2 a monogenic ratio of the two colours (actual numbers 34 and 15) was obtained. Its relation with other types is under investigation but it may be concluded that the purple-veined flowers are caused by a distinct gene, which we have designated as Pu.

B. S. KADAM.
S. M. PATEL.
V. K. PATANKAR.

Cereal Breeding Station,
Kundewadi, Niphad, Bombay,
January 21, 1941.

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[1] Howard, A. G., Howard, L. C., and Khan, A. R., *Mem. Dept. Agri. India Bot. Ser.*, 1915, **7.**

[2] Shaw, F. J. F., and Khan, A. R., *ibid.*, 1931, **19.**

[3] Khan, A. R., and Akhtar, A. R., *Agric. and Live-Stock in India*, 1934, **4.**

[4] Singh, H., and Ekbote, R. B., *Ind. Journ. Agric. Sc.*, 1936, **6.**

[5] Ayyar, V. R., and Balsubramaniam, R., *Proc. Indian Academy of Sciences*, Sec. B, 1936, **4.**

ADVENTITIOUS ROOTS OF RAGI (*ELEUSINE CORACANA*, GAERTN.)

IT is a well-known fact that in all grasses there is a ring of root-meristem at the base of each node. From this region the roots are induced to grow and function as normal ones whenever the nodes come in contact with the humid soil. The stems when broken can establish themselves as new plants. This capacity to form the roots at the nodes may be considered as one of the chief causes for the rapid multiplication and spread of the grasses and also the dominant position they occupy to-day in the plant kingdom.

This quality has been since very early times made use of in the propagation of some of the cultivated grasses as sugarcane. In the cultivated sorghums also, the adventitious roots are developed to a greater or smaller extent in all the nodes (Ayyangar, G. N. R., and Rao, V. P.[1]). New plants of sorghum have been successfully raised by setts as in the case of sugarcane (Thomas, R., and Venkataraman, T. S.,[2]

Rea, H. E., and Karper, R. E.[3]). The latter authors found that in the Maize (Mosshart Yellow Dent Corn) no new plants could be obtained since only root growth was induced and no shoot growth. Recently a sample of cuttings of stems (without roots) of *Echinochloa colona* var. *frumentacea* was received at the Millets Breeding Station. These cuttings when planted in pots struck roots easily and developed into well-grown plants.

FIG. 1. (*a*) Internodes showing roots at nodes; (*b*) axillary bud from upper node, with long roots. Usually the axillary bud grows into a branch without roots

In Ragi the development of the adventitious roots in the upper nodes is not found, though they develop occasionally when the nodes come in contact with wet soil. In some of the plants from X-rayed seeds grown in 1940, it was noted that profuse, long, thin, wiry roots had developed in almost every node (Fig. 1). The internodes usually remain enclosed in the leaf sheath and therefore the roots grow along the internodes closely adpressed to it, till they reach the lower node. Here their further elongation is obstructed by the leaf sheath base. They therefore tend to grow round the stems and encircle it. Most often the roots become much branched and a mat of roots just above the node results. There is good development of root hairs at the root tips. Ragi is an annual plant. Its capacity to form the adventitious roots therefore presents a possibility of propagating desirable plants which would otherwise be lost through seed formation or in the multiplication of rare hybrids and thus obtain a greater quantity of seeds.

N. KRISHNASWAMY.
G. N. RANGASWAMY AYYANGAR.
Millets Breeding Station,
Coimbatore,
January 22, 1941.

[1] *Curr. Sci.*, 1935, **3**, 485.
[2] *Agric. Jour. India.*, 1930, **25**, 164.
[3] *Amer. Jour. Bot.*, 1932, **19**, 464.

THE INHERITANCE OF THE MANIFESTATION OF PURPLE COLOUR AT THE PULVINAR REGIONS IN THE PANICLES OF SORGHUM

ANTHOCYANIC purple pigmentation manifests itself in various parts of the sorghum plant and in various stages of its growth. The existing knowledge on this subject has been summarised recently.[1] When the shoot (coleoptile) is coloured purple (gene PC), the axil of the leaf-sheath is also coloured purple. When the shoot is deep purple, the axil is coloured deep purple and in addition to this the auricular junction (gene PJ), the outer margins of the leaf-sheath and the nodal band are also coloured purple. When the auricular junction is coloured purple, the anther may or may not be coloured purple; but when the anther is

coloured purple, the auricular junction is always coloured purple.[2]

In the panicle, there are usually specialised cushiony tissues called the pulvinii, at the place of insertion of the branches into the main stalk of the branchlets into the branches, and of the pedicels of spikelets into the branchlets. These help in the movement of the branches of the panicle exposed to high winds. These panicular pulvinii are homologous to the auricular junctions. When the leaves are non-auriculate, the panicles lack the pulvinii, and the panicle branches are adpressed to the main stalk.[3]

Among the rare places at which purple pigment may manifest itself are the anther sacs and the pulvinii in the panicle. Purple coloured anthers and pulvinii are rare in sorghum. They go with a deep purple coleoptile, which character is African in origin. A deep purple coleoptile goes with a purple coloured auricular junction, which latter character is also African in origin. So is the anther purple character.

It has been noticed that when the anther is coloured purple, the pulvinus in the panicle is always coloured purple. Plants with purple coloured pulvinii may rarely have the anther of their flowers non-purple coloured. Similarly though the auricular junction be purple coloured, the panicular pulvinus may be non-purple coloured.

In the following table are given the cultivated sorghum varieties, having purple coloured pulvinii, picked out from the world collection at the Millets Breeding Station, Coimbatore.

M.B.S. Selection Number	Botanical Name	African Name	Source in Africa	Colour of		
				Auricular junction	Panicular pulvinus	Fresh anther-sac
A.S. 3947	*Sorghum Roxburghii*	Gebere	Tanganyika	Purple	Purple	Purple
A.S. 3981	*S. elegans*	Chamzingo	,,	,,	,,	,,
A.S. 4575	,,	Mdula	,,	,,	,,	,,
A.S. 4590	,,	Kitembo	,,	,,	,,	Light Purple
A.S. 4378	*S. coriaceum*	Meelepu	North Rhodesia	,,	,,	Purple
A.S. 4592	*S. nigricans*	Chamzingo	Tanganyika	,,	,,	Light Purple
A.S. 4660	,,	Kikuma	,,	,,	,,	Purple
A.S. 4661	,,	,,	,,	,,	,,	,,
A.S. 4662	,,	,,	,,	,,	,,	,,
A.S. 4537	*S. caudatum*	Dakkata	Nigeria	,,	,,	Light Purple
A.S. 4547	,,	Jardiya	,,	,,	,,	Yellow

In the wild sorghums it is interesting to note that this character is found in four species—*S. versicolor, S. purpureosericeum, S. dimidiatum* and *S. halepense*—all of which are African in origin. Hence it may safely be concluded that this rare character is African in origin, most of the cultivated types having it, coming from the Tanganyika territory.

The purple colour appears at the pulvinar regions of the panicle just before the plant begins to flower. The cushiony tissue at these regions develops purple spots to begin with and then turns completely purple, as the flowering progresses. When the flowering is complete, the purple colour begins to fade, and disappears in two or three days. The best manifestation is at the flowering stage.

To examine the inheritance of this character

in its simple manifestation, a cross was made between the two following parents:—

Selection Number	Auricular junction	Colour of panicular pulvinus	Fresh auther-sac
♀ A.S. 4547	Purple	Purple	Yellow
♂ A.S. 4554	,,	No-Purple	,,
F_1 ..	,,	Purple	,,

The F_2 gave a simple monohybrid segregation, the numbers being 184 plants with purple and 57 with colourless pulvinii. In the F_3, of the four families raised, one was pure for purple pulvinii, and three segregated as in the F_2, the total of the three families being 173 purple and 60 colourless pulvinii. This capacity to take on anthocyanic purple pigmentation in panicular pulvinii, is thus a monogenic dominant.

In the above cross the parents differed also in the juiciness of their stalks, and cross collations gave pithy-coloured, pithy-colourless, and juicy-coloured and juicy-colourless plants in the ratio of 174, 58, 62 and 15, indicating that this character (gene D)[4] is independent of the character inducing the manifestation of purple pigment in panicular pulvinii.

It will thus be seen that anthocyanic purple pigment occurs in such obscure parts as panicular pulvinii, in certain rare types of African sorghum, mostly from the Tanganyika territory. This character is a monogenic dominant to its absence, and forms part of a chain of manifestation in which the auricular junction and the anther participate.

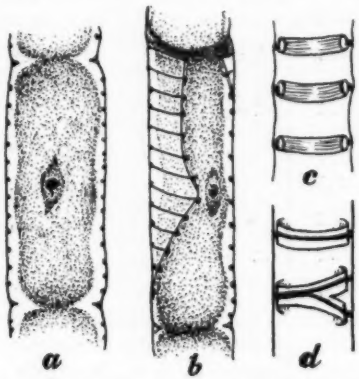
G. N. Rangaswami Ayyangar.
A. Kunhi Koran Nambiar.
Millets Breeding Station,
Coimbatore,
January 22, 1941.

[1] *Jour. Madras University*, 1938, **2**, 131.
[2] *Proc. Ind. Acad. Sci.*, 1938, **8**, 318.
[3] *Ibid.*, 1938, **6**, 286.
[4] *Madras Agrl. Jour.*, 1937, **5**, 157.

THE ORIGIN AND NATURE OF THE *BASES* OF THE SECONDARY THICKENINGS OF XYLEM VESSELS IN *HERACLEUM SPHONDYLIUM* L.

Rothert[1] was the first to point out that the secondary thickenings (bands) of xylem vessels are not inserted *directly* on the primary walls, but are attached to the latter by *bases*. According to him these are formed ontogenetically by the contraction of the dorsal side of the bands themselves.

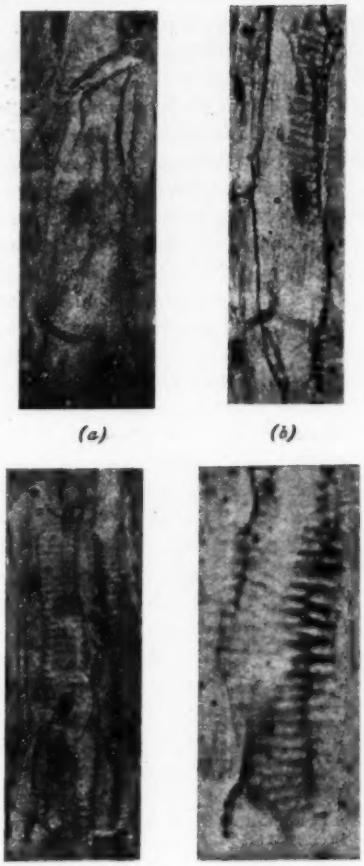
The developmental studies in *Heracleum* show that the origin of these bases is independent of the bands. When the vessel segments, during their differentiation, have attained their fullest expansion the bases are deposited as localised thickenings on the inner



(Semi-diagrammatic) vessel segments showing different stages in the development of a *base*: *a*, base in cross section on primary wall; *b*, part of the primary wall and bases in surface view; *c*, primary wall, bases and their bands in l. s. of the vessel segment; *d*, base and its band in surface view.

surface of their primary longitudinal walls in the pattern of the bands to be deposited soon after. Their chemical nature appears to be the same as that of the primary wall as they stain equally deeply with fast green. In cross-section these local thickenings appear as fine dots (Fig. 1 *a*, *b*). Microchemical and other tests show that they are more pectin than cellulose.

These localised thickenings of the primary wall ultimately form slight projections into the cavity of the vessel segments, and



(a) (b) (c) (d)

FIG. 2

Photomicrographs of stages shown diagrammatically in Fig. 1 *a*, *b*, *c*, & *d*, respectively.

these projections secondary layers are subsequently laid down by the protoplasts (Fig. 1 c, d). When lignification of the bands has proceeded for some time and the colour reaction with safranin is rather light or faint these projections stained with fast green appear as bright green lines running through the centre of each band across the wall of the vessel (Figs. 1 d). In strongly lignified bands the bases can no longer be distinguished by colour reaction.

Thus the *base* in *Heracleum* is different from its band both in origin and in chemical nature. It is not an integral part of the band and is not formed by the contraction of the base as Rothert believed. Neither Barkley,[2] Esau,[3] nor Murray Scott[4] noticed any contraction of the bars once they were formed, during or prior to lignification. Haberlandt[5] describes some plants in which the insertion of the fibres (bands) is never seen to be contracted at all.

G. P. MAJUMDAR.

Botanical Laboratories,
Presidency College, Calcutta,
December 11, 1940.

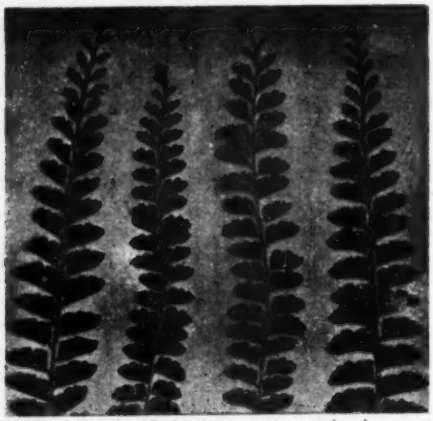
[1] Rothert, *Bull. Akad. Crac.*, 1899, cited in 3.
[2] G. Barkley, *Bot. Gaz.*, 1927, **83**, 173.
[3] K. Esau, *Hilgardia*, 1936, **10**, 431.
[4] Murray Scott, *Madrono*, 1933, **3**, 190.
[5] G. Haberlandt, *Physiol. Plant Anat.*, Eng. ed., 1914.

A MYCELIAL FUNGUS ON LIVING LEAVES OF *LINDSAYA CULTRATA*

ONLY a few fungi are known to occur on ferns but none seem to have been recorded on *Lindsaya cultrata* of the Polypodiaceæ (*cf.* Oudemans,[1] Verdoorn[2] and Saccardo[3]). The writer has observed a large number of living fronds of this fern to be heavily infected by a mycelial fungus at Ghoom in the district of Darjeeling, Bengal, in the month of September. The infected plants were growing in shady moist places.

Externally very slightly raised blackish spots are found at the margin of the leaflets on their lower surface as can be seen in the accompanying photograph. There are many minute nearly circular spots in a single leaflet but a number of them may coalesce to form large irregular black patches up to 5 mm. in length. On the upper surface smaller black dots are seen at places corresponding in position to the infected areas on the lower side. A large number of specimens have been examined but no spores of any kind could be found. The mycelium is branched, septate and dark brown in colour. It ramifies freely in the intercellular spaces of the infected region of the leaf but does not send haustoria into the cells. Many hyphæ are found collected in the sub-stomatal spaces. Some of them come out through the stoma and form

a sort of compact, dark brown to black, circular stroma outside, thus blocking the pore. A large number of stomata are found to be blocked by these stromata.



Infected leaves of *Lindsaya cultrata* showing spots due to the mycelial fungus *Ectrostoma*

No spores of any kind could be found. So the fungus may be provisionally placed in the group *Mycelia sterilia* of the *Fungi imperfecti*. As it is maculiform and produces black stromata on the leaves it is probably some species of *Ectostroma*. A fuller description of this fungus together with its specific determination will appear elsewhere.

A. K. Mitra.

Department of Botany,
University of Allahabad,
January 2, 1941.

[1] Oudemans, C. A. J. A., *Enumeratio Systematica Fungorum*, 1924.
[2] Verdoorn, Fr., *Manual of Pteridology*, 1938.
[3] Saccardo, P. A., *Sylloge Fungorum*.

THE FUNCTION OF PROTOZOA IN THE ACTIVATED SLUDGE PROCESS

It is now generally recognised that the occurrence of certain forms of protozoa in the activated sludge tank is closely associated with the efficiency of the process of purification. It has also been conversely observed that, as the protozoa either diminish in numbers or occur encysted due to deficiency of aeration or other unfavourable conditions, sludge formation is poor and the resulting effluent unsatisfactory. Richards and Sawyer[1] reported that, in so far as the protozoa kept down the bacterial numbers they might be regarded as detrimental to the purification. They found, however, that the increase in bacterial numbers following suppression of protozoa by partial sterilization produced no improvement in the purification of sewage; on the contrary, both carbon and nitrogen 'fermentations' were seriously retarded. Furthermore, there was a change in bacterial flora, nitrifying organisms being suppressed by the treatment. Cramer[2] observed that, after reaching a certain stage of development, the protozoa die and disintegrate thus affording food for bacteria.

With a view to obtaining some direct information regarding the part played by protozoa, both singly and collectively, in activated sludge, a series of experiments were carried out isolating several prominent strains and by inoculating them in different ways into experimental bottles containing equal quantities (1½ litres) of sterile raw sewage (prepared according to Butterfield *et al*[3]) and bubbling air through them. These included four forms of protozoa and thirteen species of aerobic bacteria. The quantities of inocula were adjusted in each case to correspond to the numbers actually present under tank conditions. The extent of sludge formation and the composition of the effluent were determined in each case at frequent intervals.

It was observed that although all the bacteria that were tried showed some sludge-forming properties, the protozoa with the associated bacteria were much more efficient. They also produced clearer and cleaner effluents. None of the bacteria yielded more than 0·4 to 0·5 per cent. of sludge; the corresponding effluents were invariably turbid. Among the protozoa, the *Vorticella* were the most efficient: they not only yielded the highest percentage of sludge (2·5 per cent.) but also gave the cleanest effluent.

The foregoing observations, though essentially of a preliminary character, yet serve to bring out the importance of protozoa in sludge formation. By forming slimy aggregates with

high adsorptive power they help to collect the major part of the colloidal matter of the sewage. The vigorous flow of diffused air keeps the resulting sludge well dispersed in the form of granules and thus facilitates its interaction with the incoming raw sewage.

Further work is in progress with special reference to the relation of protozoa to nitrification and other oxidation changes in the activated sludge tank.

S. C. Pillai.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
January 6, 1941.

[1] Richards, E. H., and Sawyer, G. C., *J. Soc. Chem. Ind.*, 1922, **41**, 62T.
[2] Cramer, R., *Ind. and Eng. Chem.*, 1931, **23**, 309.
[3] Butterfield, C. T., *et al.*, *U. S. Treasury Dept. Public Health Reports*, 1937, **52**, 387.

A NEW ASPECT OF HYDROPONICS: "HANGING GARDENS" IN THE ACTIVATED SLUDGE TANK

The art of farming without soil has recently awakened considerable public interest. By employing the familiar method of 'water cultures' a great deal of work has been carried out during the last two years particularly in California[1] and in England.[2]

The conditions obtaining in the aeration tanks of the activated sludge installation, the presence of practically all the elements of plant nutrition as also plenty of air, would show that it is suited to setting up what may be termed "Hanging Gardens". Suitable trays made of wood or tin or any other material which is not likely to be attacked by the liquid in the tank or the gases evolved therefrom may be used for growing the plants. Trays of convenient sizes, provided with strong open wire mesh bottom and filled with pebbles graded up to fine soil at the top or some fibrous material like coir fibre, would be suitable for the purpose; straw may also be used as bedding for the growing plants. Such boxes or trays with the desired plants may be hung, properly supported, in the aeration chambers of the tank so that the tank liquid reaches only up to the top of the pebbles or the bottom layer of the fibrous material, as the case may be. Provision may also be made for the boxes to float and maintain their position on the surface of the aeration tanks and adjust themselves with the rise and fall of the liquid, by having sealed tins filled with air attached to the bottom of the boxes.

At the suggestion of Dr. Gilbert J. Fowler, a systematic investigation into the possibilities of growing the various food plants and flower plants in the activated sludge tank at the Indian Institute of Science was undertaken. The growth of rice, ragi, tomatoes, chillies, roses, tuberoses and marygold by the system of "Hanging Gardens" has been studied and, in certain cases, highly promising results have been obtained. The plants showed highly luxuriant growth and were, in fact, almost giant specimens. Tillering and ear bearing in the case of rice and ragi were indeed phenomenal. Most of the rice plants put forth more than 50 tillers.

Work is being extended to other crops and flowering plants. It would appear that apart from the possible utilisation of the activated sludge process, especially large works, for agricultural and horticultural purposes, the system of "Hanging Gardens" will also prove an elegant technique for studying some of the fundamental problems of plant nutrition, more especially the nature of the microflora and fauna under the conditions of plant growth, since the microbiological changes which proceed in the activated sludge tank are essentially the same as those in the soil.

S. C. Pillai.

Department of Biochemistry,
Indian Institute of Science,
Bangalore,
January 6, 1941.

[1] Gericke, W. F., *Nature*, 1938, **141**, 536; —, 'The Complete Guide to Soilless Gardening'. (Putnam & Co., Ltd., London, 1940.)
[2] Cheshnut Experimental Station *Ann. Rep.*, 1939, p. 13; Millard and Stoughton, *Sci. Hort.*, 1939, **7**, 174; Templeman and Watson, *J. Min. Agric.*, 1938–39, **45**, 771; Hilyer, C. I., Hydroponics: Food without Soil; a Journal of Experiments, 1938–1940, p. 116. Pelican Special S 63 published by Penguin Books Ltd.
Russell, E. J., *Nature*, 1940, **146**, 448.

SOIL ALGAE OF LAHORE

DR. JAGJIWAN SINGH has published a short note on the above subject in the January 1941 issue of the *Current Science*. The justification for publishing such a note is his supposed new record of three genera not previously recorded from soil. These are *Pandorina*, *Trachelomonas* and *Phacotus*. Sandon, from Rothamsted Microbiology Department, in his book on "Composition and Distribution of Protozoan Fauna of the Soil", has noted *Pandorina morum* and *Trachelomonas volvocina* as regular soil forms. The former is widely distributed and has been recorded by Sandon from various countries including India. *Trachelomonas* has also been recorded from this country. Regarding identification of *Phacotus* from the soil, it seems that the author has confused it with *Chlamydomonas*, one of the commonest soil forms. The undersigned has seen his drawings, but there was no *Phacotus*.

A comprehensive list of algal flora of the Lahore soils has been published from this laboratory by Hardyal Singh[1] and a list of soil flagellates and ciliates occurring on Indian soils from twenty-four different parts of the country has been published by the undersigned.[2]

H. CHAUDHURI.

Department of Botany,
Panjab University, Lahore,
January 31, 1941.

[1] *J. Ind. Bot. Soc.*, 1933, **12**, 102.
[2] *Annales de Protistologie*, 1929, **2**, Fasc. I, Vol. II, pp. 41–60.

INDUSTRIAL RESEARCH UTILISATION COMMITTEE

THE formation of the utilisation committee by the Government of India, to assess the commercial worthiness of completed pieces of industrial research, constitutes a welcome and praiseworthy step which must assure the public of the intensely practical and business-like manner in which the Board of Scientific and Industrial Research is conducting its work.

Valuable results from research schemes instituted at the instance of the Board of Scientific and Industrial Research or conducted at the Central Government's Laboratories at Alipore, Calcutta, have already been achieved and the possibility of their industrial utilisation proved to the satisfaction of the Board. The time has now come to decide on how best these results can be utilised in practice. The Government of India have come to the conclusion that they should take the advice in this connection of a Committee of non-officials to be called the Industrial Research Utilisation Committee. The Committee, will be presided over by the Hon. Diwan Bahadur Sir A. Ramaswami Mudaliar, Member of the Governor-General's Executive Council in charge of the Departments of Commerce and Labour. Its members will be: Sir Shri Ram, New Delhi; Sir Ardeshir Dalal, Bombay; Sir Homi Mody, Bombay; Sir Sultan Ahmad, Patna; Mr. Kasturbhai Lalbhai, Ahmedabad; Mr. P. F. S. Warren, Calcutta; Dr. Narendra Nath Law, Calcutta; the Hon'ble Mr. J. H. S. Richardson, Calcutta; Sir Frederick James, Madras; Sir Rahimtoola Chinoy, Bombay; Sir Jwala Prasad Srivastava, Cawnpore; Khan Bahadur Sir Saiyed Maratab Ali Shah, Lahore; Sir Abdul Halim Ghuznavi, Calcutta; Diwan Bahadur C. S. Ratnasabhapathy Mudaliar, Coimbatore; Mr. Nalini Ranjan Sarkar, Calcutta; Mr. F. Stones, Bombay and Dr. Sir Santi Swarup Bhatnagar, Director of Scientific and Industrial Research, Calcutta, co-opted as a member. Mr. T. S. Pillai, General Secretary of the Board of Scientific and Industrial Research, will be the Secretary.

The functions of the Committee will be to advise the Central Government on: (1) the selection of the particular industrial concern or concerns to which the results of research schemes should be made available for utilisation; (2) the terms and conditions, including the question of payment for royalties, etc., on which this can be done; (3) the question of the division of the royalties on patent rights, which will vest in the Central Government on the one hand, and, on the other, the Provincial Governments, institutions, and scientists responsible for the research, and as among the scientists themselves; and (4) generally the best methods whereby the industrial development of the research can be undertaken and an equitable arrangement made for securing that the services of the scientists concerned are adequately rewarded. The Central Government will be the final authority to decide how the results of research schemes placed before the Industrial Research Utilisation Committee will be utilised and by whom, and on all other matters on which the advice of the Committee is sought.

REVIEWS

General Physics for Students of Science. By Robert Bruce Lindsay. (John Wiley & Sons, Inc., New York; Chapman & Hall, Ltd., London), 1940. Pp. 554. Price 22*sh.* 6*d.*

It is difficult to write a book purporting to cover the whole of physics, aiming at a fairly high standard, within the limits of a single volume, when advance in every branch is both rapid and profound. In fact the tendency is to devote books to particular branches of physics.

The present book is an attempt to cover in a single volume of 554 pages the whole range of physics, including some of the more recent developments. The standard aimed at can be gauged from the fact that simple calculus methods are freely employed and a small attempt is made to introduce vector methods in certain parts. The subject-matter is divided into five parts comprising 29 chapters.

The first part, chapters 1 to 3, gives a general introduction, dealing with scientific method, a historical review of the progress of physics from Aristotle to the present day and a short exposition of the general properties of matter. Part two is devoted to mechanics, dealing with general dynamics, oscillatory motion, work and energy, gravitation and planetary motion, systems of particles, motion of a rigid body, statics, elasticity and some properties of liquids, in succession. The five chapters of part three are given to heat, including a short treatment of the kinetic theory and thermodynamics. Magnetism and electricity are comprised in part four, wherein alternating current circuits, and electrical discharge through gases are included. Part five, styled Radiation, deals in succession with sound, geometrical and physical optics, thermal and spectral radiation, with a short excursion into atomic structure.

It will thus be seen that an attempt is made to traverse the most important fields in physics in a comparatively short compass. The treatment is naturally not detailed or intensive, though a clear exposition of such topics as are taken up is attempted. Lack of adequate space limits the scope of such attempts. As a text-book for students of other sciences to obtain an insight into the domain of physics, the book will be very useful. But for those who specialise in physics to the standard attempted in the book—which may be taken as the B.Sc. standard—the book may fall short of their needs.

Each chapter is followed by a good selection of examples illustrative of the principles embodied in the chapter.

Errors are few, but we may point out on page 81 the definition of an erg as the energy of 1 gm. moving at 1 cm. per second.

A. V. T.

Electrical Measurements in Principle and Practice. By H. Cobden Turner and E. H. W. Banner. (Chapman & Hall, Ltd., London). Pp. 354. Figs. 219. Price 7*sh.* 6*d.*

This is a cheaper edition of the book which was first published in 1935. It meets the long-felt want for a book dealing with the general description and working of the various types of measuring instruments that any electrical engineer may come across. The list of instruments described is almost exhaustive and the treatment clear and simple. The use of mathematics with which many operating engineers feel rather uneasy, has been avoided. The technical terms, symbols and abbreviations employed are in accordance with the recommendations of the British Standards Institution.

The book is divided into five parts. The first part consists of three chapters dealing with units and standards, the second part is divided into nine chapters giving general descriptions of almost all the different types of electrical measuring instruments met with in practice. Parts III and IV consist of three and five chapters respectively dealing with electrical measurements. The last part which consists of four chapters covers indirect electrical measurements some of which such as the 'dryness of timber' and 'acidity of fruits' are interesting.

The authors might consider the following suggestions before the publication of the next edition:

(1) More adequate treatment of the testing of Energy Meters and Instrument Transformers.

(2) The addition of a chapter on high voltage tests on insulators and insulating materials.

The book is abundantly illustrated. A

glossary of technical terms and a few charts indicating at a glance the scope and range of the various measuring instruments employed are other desirable features. The get-up of the book is good and its low price of 7*sh.* 6*d.* brings it within reach of almost everyone. K. ASTON.

Television: The Electronics of Image Transmission. By V. K. Zworykin and G. A. Morton. (Chapman & Hall, Ltd., London), 1940. Pp. 646. Price 36*sh.*

This book on the electronic aspect of television by two of the foremost workers in the field, supplies to the radio engineer and experimenter a long-felt need for an authoritative work on the subject. So far as the reviewer is aware, this is the first book on the electronics of television meriting the name of a reference book which brings together the more relevant parts of the numerous technical papers that have appeared during recent years.

The book opens with a brief historic survey of the discovery of electrons and the photoelectric effect leading on to the discussion of such phenomena as the photoelectric and thermionic emission of electrons, the mechanism of luminescence and certain aspects of electron optics, and several other physical principles that provide a useful background for the proper understanding of the subject. The second part deals with the general principles of television and gives a fairly clear conception of the factors contributing to the quality of pictures in relation to the various physical methods employed. Such items as synchronization, scanning, amplifiers, and certain aspects of high frequency transmission and reception of television signals, are all dwelt upon. What is probably most interesting from a practical point of view is the section dealing with the various component parts and electronic devices employed in television; like iconoscopes, kinescopes, electron guns, etc., and their methods of construction. Sufficient practical details are included to enable one to construct some of these devices in the laboratory. This feature in conjunction with a very detailed account of a model television receiver (a circuit diagram of which is given with the values of the component parts) should prove to be valuable to those entering this interesting field.

What would appear as a discontinuity of subject-matter in the chapters of the main text is partly made up towards the end, by a detailed description of the sequence of working of a typical television equipment at RCA and NBC installations.

The concluding part of the book deals with the nature of certain television problems and the future of television, and gives an extremely practical view-point of the television art, and its future, as gauged from its present stage of development, by one whose contributions to the subject are so well known.

The book is profusely illustrated with neat diagrams and leaves nothing to be desired in the nature of artistic get up. The bibliography at the conclusion of each chapter should prove very useful and will be appreciated by those who need original references. The book should prove of great value to the engineer, the experimenter and to all those interested in the subject, and should find a prominent place in every technical library. C. C.

Intermediate Practical Physics. By T. M. Yarwood. (MacMillan & Co., London), 1940. Pp. 307 + xii. Price 6*sh.*

The book is well written, describing 106 different experiments ranging over the whole course in Physics. Each experiment begins with a statement of the apparatus required, followed by a brief description of procedure. The formulæ required are written out and figures and diagrams given showing the apparatus, its disposition and working wherever necessary. Tabular statements and graphical methods of studying results are provided. Thus the description, though generally brief, is precise and helpful.

The first chapter is devoted to general instructions dealing with procedure, errors of observation, limits of accuracy, methods of calculation and graphical work. Ten pages towards the end contain some 20 tables of useful physical data, and these are followed by four-figure tables of logs, antilogs, sines, cosines and tangents.

Several of the experiments are probably outside the normal routine of the Intermediate courses of most Indian universities, though these differ in their standards in individual subjects, depending on the number of subjects taught, the attention devoted to languages and the number of hours assigned to practical work per week. Thus, experiments on Young's modulus, surface tension, viscosity, Clement and Desorme's experiment, fourth power law of radiation,

Newton's rings, Lloyd's mirror, Kundt's tube, magnetisation curves, earth inductor and capacities of condensers, to mention a few, are likely to lie beyond the scope of the syllabus, practical or theoretical, of Intermediate courses in most Indian universities. However, it is possible to make a judicious selection of experiments to suit any Intermediate course, from those given in the book. A. V. T.

Plant Viruses and Virus Diseases. By F. C. Bawden. (Chronica Botanica Co., Leiden-Holland), 1939. Pp. 272. Price 7 guilders.

Although virus diseases of animals and plants were recognised since the middle of the last century, the nature of their causal entity remained obscure for a considerable time. The study of viruses was rendered difficult by the fact that their isolation and culture could not be achieved by the orthodox methods practised by bacteriologists and mycologists. The early investigations in the field of virus diseases were mainly directed towards the elucidation of symptomatology, mode of artificial and natural transmissions, relationships between viruses and their vectors, range of host-plants, and the nature of immunity in hosts.

With the discovery of Stanley in 1935, that the tobacco mosaic virus could be obtained in a state of crystallinity, a new era of spectacular progress in this field was ushered in. A wide circle of scientific investigators immediately got themselves interested in a field of research, till then considered purely biological and obscure. Bawden and Pirie were the first to establish the nucleoprotein character of the mosaic virus. Chemists, crystallographers, serologists, physicists, and others have interested themselves in a fascinating study of these intriguing pathogens, many of which could be obtained in a state of perfect crystallinity. Their intensive labours have resulted in the accumulation of a large volume of significant data. Bawden's contributions in this field have been both intensive and substantial. There was the imperative need to correlate and critically appraise these data. The appearance of the volume on this subject is therefore timely and appropriate. It would be difficult to find an equal more competent to handle the subject with the critical thoroughness, logic and clarity which distinguish the entire volume. By producing this classic, the author has placed a wide circle of investigators in this field under a deep debt of gratitude. M. S.

Annual Review of Physiology, Vol. II. By James Murray Luck and Victor E. Hall. (American Physiological Society and Annual Reviews Inc.), 1940. Pp. vii + 501. Price $5·00.

The second volume of this new series of Annual Reviews has appeared in spite of the terrible distractions of war confronting the world; the direct result of this unhappy state is reflected in the fact that there are no contributions from Europe which is the scene of the crisis. It is indeed creditable and flattering to the American continent that, in spite of this unavoidable exclusion of European physiologists, a comprehensive review on the most important topics of physiological research has been presented in this volume.

Twenty reviews comprising the volume cover the field of the physiology of tissues and tissue fluids like, the blood and the lymph. Important systems and processes which are fundamental to life, like respiration, the heart, the central nervous system, the autonomous nervous system, reproductive organs, the digestive system, have been individually treated; progress in the field of the special senses and the endocrine glands are covered by two separate reviews.

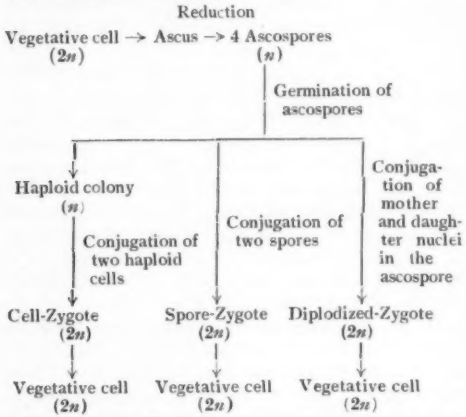
Of special interest to organic chemists and pharmacologists are the two chapters on the pharmacology of barbiturates and arsenicals. The review on the defense mechanisms in infectious and related diseases is very stimulating while that devoted to exercise has a public appeal in a country where national fitness has long been neglected. The part which physiological researches could play in the removal of "physical illiteracy" and the attainment of National Fitness and efficiency, is revealed in this chapter. Attention should be invited to the chapter on physiological psychology which contains a useful summary of the researches carried out in this field, particularly the influence of harmones and vitamins on the emotional and intellectual qualities of the animal.

Like its companion series, the Annual Reviews of Physiology will render themselves indispensable to all chemists, physiologists, psychologists and to the progressive man of medicine. M. S.

THE CYTOLOGY AND GENETICS OF YEASTS

IN 1935 Prof. O. Winge announced his pioneering researches[1] on the artificial hybridisation of yeasts. Five papers[2,3,4,5,6] which have since appeared from his laboratories constitute a valuable series of researches on the genetics of yeasts. More than a dozen yeast hybrids, one of them possessing remarkable characteristics of value to the brewing industry, have been evolved by Prof. Winge.

It was generally believed that the vegetative phase in the life-cycle of yeasts was haploid and that the ascospores in the saccharomycetes were parthenogenetically formed. By adopting an elegant microtechnique, Prof. Winge isolated and cultured individually under the microscope, all the four ascospores of an ascus. This technique facilitated the observation of all the cells of a microcolony. As a result of his studies, Prof. Winge showed that the life-cycle among saccharomycetes may be represented schematically as follows[1,2]:—



The one significant fact which emerges out of this work is that in the genus saccharomycetes, the cells are continuously diploid in the vegetative phase; there is a definite alteration of haploid and diploid generations in the life-cycle. Further, the ascospores germinate and produce the next generation of vegetative cells in any one of the following three ways: (*a*) The ascospores germinate to produce a haploid colony of limited size whose cells are characteristically round and non-sporulating on plaster block directly on transference. The cells of this colony conjugate to give multiple cell-zygotes which, on germination, give rise to the diploid cells, characteristically elongated, distally budding and chain forming and directly sporulating on plaster block. It is evident that the isolation and germination the cell-zygote produced as a result of cell fusion in the haploid colony, gives a completely homozygous yeast. It is also evident that the fusing cells in the haploid colony are not distinguishable regarding their sex both genotypically and phenotypically. (*b*) A pair of ascospores conjugate and give rise to a sporezygote which on germination gives the typically elongated vegetative cells. (*c*) Direct diplodization of the ascospore nucleus takes place, i.e., the daughter and the mother nuclei fuse in the ascospore itself without giving rise to a bud. On germination, this diplodized zygote gives rise to the vegetative cells directly. It is this behaviour that was responsible for the older conception of the parthenogenetic origin of ascospores in saccharomycetes.

The study of the germination behaviour of ascospores in successive generations of cells, revealed that ascospores from yeasts originating from diplodized zygotes have such a low germinating power as to render the yeast almost sterile. This sterility, according to Prof. Winge and his collaborator is due to the effect of inbreeding on the cytoplasm, particularly, to the maldistribution of chondriosomes amongst the ascospores.[6]

It will be noticed that no work has been done on the chromosome complement in these yeasts. Though the genetical work leaves no doubt as to the reality of the alternation of generations in saccharomycetes; for scientific completeness the chromosome counts in the haploid and diploid phases is necessary.

Winge and Laustsen[2] demonstrated the genetic segregations in the ascus of a variety of *Saccharomyces ellipsoideus*. Their method consisted in isolating all the four ascospores from an ascus by means of the microtechnique and growing them into giant colonies individually on gelatine. In a typical experiment, two spores germinated forming haploid cells and the remaining two germinated directly into diploid cells. Apparently the latter two ascospores were diplodized zygotes. Of the former two haploid cell microcolonies, one was observed to produce cell zygotes while the other remained sterile, i.e., all attempts to induce zygote formation failed. The cells of this sterile segregate resembled Toruloid yeast. The cell zygotes of the other microcolony behaved normally (i.e., they produced actively budding vegetative cells) and *also* sporulated immediately on transference to the plaster block, thus strongly recalling the sporulating behaviour of Zygosaccharomycetes. The easily observable macromorphological features of these four segregates on gelatine, three being diploid giant colonies and the remaining one being sterile haploid giant colony, strikingly demonstrated the genetic segregation in the ascus. In this connection, two other points must be stated: the segregating types are not identical from ascus to ascus and there is not always pairwise identity in the four giant colonies. The former fact shows that macromorphological features are multifactorially controlled and the latter fact shows that crossing-over is not infrequent during reduction division.

In two subsequent papers[3,4] the authors present results of their extensive work on artificial hybridization amongst the members of the genus Saccharomyces, resulting in no less than fourteen hybrids, some interspecific and others

being intervarietal hybrids. The method of bringing about the cross was to bring the two spores of the parent yeasts in a droplet of wort and to observe under the microscope the spore zygote formation. This is achieved only after a number of trials, since it is purely a matter of chance that the two spores should germinate simultaneously and effectively conjugate.

The interspecific cross between *Saccharomyces ellipsoideus* (baking yeast) and *S. validus* has been presented by the authors in great detail.[3,4] An attempt is made to summarise the results in the following table:—

	Baking yeast	*S. validus*	*Hybrid*
1. Cells ..	Oval	Elongated	Oval but distinguishable from cells of the baking yeast
2. Sediment in wort ..	Smooth	Highly granulated	Intermediate to that of parents
3. Giant colony ..	Circular in shape with delicate silky radiate striation[1]	Very irregular outline, rough sculpture of irregular concentric and radiate winding, deep furrows twisted almost like a cerebral	Intermediate to a certain extent, with pronounced concentric and radiate furrows and irregular outline
4. Germinating capacity of the ascospores	68 per cent.	78 per cent.	2 per cent
5. Biochemical character ..	Ferments only ⅓ of raffinose, *i.e.*, the yeast produces raffinase but not melibiase	Ferments raffinose completely and hence produces both raffinase and melibiase	Ferments raffinose completely, showing thereby that the presence of an enzyme is dominant over its absence
6. Rate of dry matter production	90 mg. in 72 hours	Variable but definitely at a much lower rate than its mate and the hybrid	98·6 mg. in 72 hours
7. Common method of zygote formation	Spore zygote	Spore zygote	Spore zygotes not formed or formed extremely rarely

The table is to a certain extent self-explanatory; two points may be noted. Firstly the low germinating power of the above hybrid is a general phenomenon common to all interspecific hybrids; in fact, low germinating capacity (0 to 13 per cent.) and high germinating capacity (50 to 94 per cent.) of the various hybrids are taken as indicative of specific differences between the parents. Secondly, specific differences in germinating capacity are accompanied by biochemical differences in fermentation.[4]

Of pure genetical interest is the author's work[5] on *Saccharomycodes Ludwigii* Hansen which has been proved to be a balanced-heterozygote involving heterothallism in the haploid phase.

The scientific and economic importance of these researches can hardly be overestimated. Scientifically this work will go a long way in clearing up the taxonomy and phylogeny of the genus Saccharomyces and other genera like Torula and Zygosaccharomyces. For preserving the constancy of type, Hansen's single-cell pure culture must be replaced by single-spore pure cultures. Systematic breeding work for obtaining yeasts of desired quality has now been rendered possible.

B. SRINIVASAN.

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[1] Winge, O., *Compt. Rend. Trav. Lab.*, Carlsberg, 1935, **21**, 77.

[2] — and Laustsen, *ibid.*, 1937, **22**, 99.

[3] — —, *ibid.*, 1938, **22**, 235.

[4] — —, *ibid.*, 1939, **22**, 337.

[5] — —, *ibid.*, 1939, **22**, 357.

[6] — —, *ibid.*, 1940, **23**, 17.

SCIENTIFIC RESEARCH AND THE FUTURE OF INDIAN INDUSTRY

IN the course of the third Sir J. C. Bose Memorial Lecture, on Scientific Research and the Future of Indian Industry, Professor Sir S. S. Bhatnagar drew attention to the lukewarm interest taken by the Government in the promotion of scientific research and to the utter lack of appreciation on the part of our industrial magnates to the possibilities of scientific research in relation to industry and the sophisticated and too philosophical a view which the scientists themselves have taken of their discoveries. Even under these difficult conditions, Sir P. C. Ray started the Bengal Chemical and Pharmaceutical Works, which is to-day, one of the principal flourishing industries in the country. He referred to the Tata Chemical Works at Mithapur which promises a new era in our planned industrial programme under the leadership of Mr. Kapilram H. Vakil. The efforts of the Alembic Chemical Works in Baroda, the activities of the Mysore Government, the Kashmir Government, Messrs. Shambhu Nath & Sons, Messrs. D. Waldie & Co., Messrs. B. K. Paul & Co., Messrs. Smith Stanistreet & Co., and the Baluchistan Government, point to a new renaissance in Indian Industry. These developments will give a fillip to scientific research which no other movement has yet been able to impart.

Professor Bhatnagar then referred to the part which the universities in the country had to play in the industrialisation of the country. The portals and laboratories of the university contain the wealth of talent, learning and imagination waiting to be tapped. He pleaded for a closer contact between industry and the universities and paid a tribute to the Universities of the Punjab, Calcutta, Bombay, Benares and Nagpur, which provide facilities for technical training and industrial research.

He drew attention to the several new industrial enterprises, like the manufacture of chlorine and bleaching powder, of nitric acid from synthetic ammonia, of benzene and toluene from coal, and of aviation lubricants.

The greatest scope for India, he declared, lies in her ability to make good by indigenous production what now constitutes a shortage in Indian industry owing to restricted imports and this presents a vast field of investigation for the technical man and the universities. In this connection he suggested the manufacture of textile machinery and textile auxiliaries—bobbins and shuttles, pickers, varnishes for healds, etc. The Board of Scientific and Industrial Research and the technical men are fully alive to the need of taking up such investigations of a character which will lead to the manufacture of auxiliaries for industries already well established in the country. The textile department of the University of Bombay, the Cotton Technology Institute and the Imperial Institute of Sugar Technology, are helping the textile and sugar industries in every possible way.

Professor Bhatnagar then gave a short resume of the research activities of the Board of Scientific and Industrial Research, which are being carried out under the auspices of fifteen research committees. He pointed out that the Indian investor should particularly investigate the possibilities of developing uses for the raw materials whose exports were so large from this country, that their disposal now constitutes a serious problem. Vegetable oil seeds, bones, and skins and leather wastes fall into this category. It is imperative that India should develop these industries in which oils and oil-seeds can be consumed. The utilisation of bones and leather wastes should also result in the development of several subsidiary industries. With the passing of the Scandinavian countries into German hands, the production of newsprint and paper pulp in India has acquired an altogether different aspect and the possibilities in these lines are being explored.

He then referred to "some laurels" already won by investigators in India in the field of industrial research. The development of the neutral glass industry by Prof. Nag and his associates, the discovery of a low-priced source of pectin by Dr. Krishna, the production of non-radio-active luminous paints by Drs. Bhatnagar and Parthasarathy, the improvement of the quality of cheap wood by impregnation with natural resins, the preparation of transparent films of great stability from halogenated rubber, the manufacture of high-grade paints and varnishes from marking nut developed by Dr. Siddiqui, the production of fibre boards and the employment of vegetable oils as diesel fuel developed by Dr. Verman, are but a few of the notable achievements.

He concluded, "Let us not forget that scientific and industrial research in this country has its handicaps. We are overburdened with all sorts of other duties. Our trade and our laws are occasionally not quite helpful, nor can it be said that political considerations do not come in the way of some of the investigators".

INDIAN CENTRAL COTTON COMMITTEE

(Conference of Scientific Research Workers)

THE Second Conference of Scientific Research Workers on Cotton, over which the President of the Committee (Mr. P. M. Kharegat) presided, was held in Bombay on the 19–21 January 1941. About fifty workers engaged in cotton research all over India attended the Conference and 45 papers covering all aspects of cotton improvement—"Cotton Genetics and Breeding", "Cotton Agriculture", "Cotton Technology", "Cotton Statistics" and "Cotton Pests and Diseases"—were read and discussed.

The first day of the Conference was devoted to the discussion of problems connected with "Cotton Genetics and Breeding" and "Cotton Statistics". A plea was put forward for a complete survey of cottons in Eastern Bengal, Assam and Burma and the need for a more intensive programme of hybridisation of cottons in India for purposes of isolating better quality types was also emphasised. In view of the prospect of the evolution of types combining the high yield and better quality of the American cottons with the hardiness of the Asiatic types, much interest was evinced in the research work on Asiatic-American crosses which was being developed at Surat. The problem as to whether there is a place for highly prolific, exceedingly short staple cotton in India was also discussed and the view was held that such cottons, under present conditions, would command a limited market.

The papers on "Cotton Agriculture" and "Cotton Technology" were considered on the second day. Considerable discussion, from the purely agricultural standpoint, took place on the effect of growing mixtures of cotton varieties on the incidence of pests and diseases on such cottons and the quality of lint. It was reported that in the Malwa tract where this practice was in vogue, the bollworm attack on Upland Cotton and the incidence of wilt in the Malvi type had considerably decreased with, at the same time, an improvement in the quality of lint compared with that of the local. Observations in Hyderabad, however, indicated that the characters of mixtures of pure *desi* types experimented with were more or less intermediate in comparison with those of the pure strains. In this connection it was mentioned that in the Punjab the incidence of root rot had appreciably decreased in cotton grown with other crops like sorghum and moth.

In the discussion on the manurial problems of cotton, stress was laid on the necessity of greater experimentation being carried out on cultivators' fields with the use of simple designs of lay-out.

In the Technological Section the influence of environmental conditions, such as atmospheric temperature and humidity, time of sowing, change of place and duration of crop, on the fibre properties of cotton received much attention.

The work done at the Technological Laboratory in connection with the prediction of the approximate spinning performance of a cotton from its fibre properties was reviewed. It was pointed out that in the older investigation by taking six fibre properties into consideration it was possible to account for variation in spinning quality in 86% of the cases, while the more recent investigations indicated that by taking the properties—fibre length, fibre weight per inch and swollen hair diameter—it is possible to account for some 89% of the variation. These investigations suggested a new method of attacking this problem as a result of which the importance of swollen hair diameter and length irregularity percentage was established. Investigations are, however, still in progress and details will in due course be published in the form of a bulletin.

The third day of the Conference was devoted to consideration of the problem involving the breeding of a 100% wilt-resistant cotton. The technique developed in Poona where work of this nature is being carried out under the supervision of the Plant Pathologist to Government with the aid of a grant from the Committee has given very encouraging results. It was pointed out that in the matter of the control of pests and diseases, the evolution of resistant types possibly plays an important part and accordingly close co-operation between entomologists, plant pathologists and breeders was emphasised.

The President in his concluding remarks emphasised the need for greater co-ordination between the various technicians and scientific workers and stressed the importance of designing means for making the results of research available to the cultivator.

INDIAN SCIENCE CONGRESS, BENARES, 1941

Summaries of Addresses of Presidents of Sections

1

MATHEMATICS AND STATISTICS

President: DR. M. R. SIDDIQI

FUNCTIONAL ANALYSIS AND MATHEMATICAL PHYSICS

A VERY important problem of Mathematical Physics is the unification of various theories connected with the different branches of this science. The task demands the creation of very powerful tools of mathematical analysis. Such tools have been developed since the beginning of the present century, and consist of the various topics in Functional Analysis.

The considerations of Abel and Liouville in the early part of the 19th century gave rise to a vast number of inversion formulæ for definite integrals which were later called "Integral Equations". Volterra, Fredholm and Hilbert developed since 1900 an extensive theory not only of the solution of integral equations, but also of the eigenvalues and of the Fourier-expansion in series of eigenfunctions as well as that of application to mathematical and physical problems. Integral equations have now become indispensable in many theories in geometry, analysis, and the whole domain of mathematical physics. The modern theories of ordinary and partial differential equations cannot be conceived without the theory of integral equations. Direct applications of this theory, without the mediation of differential equations have been made to statistics, kinetic theory of gases and the theory of radiation.

It is now recognised that evolution is not only of the non-hereditary character dealt with in classical mechanics and physics. These classical theories were based on the principle that the present state of a system determines all its future states. This determinism is a consequence of the conception that each action manifests itself only at the instant when it takes place, and leaves no heritage. This is the same thing as the assumption that the system does not conserve the memory of those actions which have affected it in the past. But all the phenomena of nature are not really produced in this way. There are a number of evolutionary phenomena in which heredity and memory play an essential role, and to which the theory of differential equations cannot be applied. The analysis proper to such phenomena is that of integro-differential equations.

When the theory of linear integral equations was built up in close analogy with a system of linear algebraic equations, it was natural to enquire whether the considerations could not be extended to non-linear integral equations. Such extensions have been made for solutions "im-kleinen" as well as "im-grossen", and Levi-Civita's problem of the propagation of two-dimensional surface waves of finite amplitude, Carleman's problem of the theory of heat radiation, the inversion problem in the theory of functionals, the equilibrium figures of rotating fluids, the dynamics of incoherent gravitating media, etc., can only be treated with the help of non-linear integral and integro-differential equations.

For the further development of functional analysis the introduction of the principle of passing from finite to infinite into the theory of determinants was of considerable significance. This made it possible to build up a theory of infinite systems of algebraic equations in complete analogy with the theory of finite systems. Thus originated the idea of functions of an infinite number of variables. Hilbert developed a systematic theory of infinite linear, bilinear and quadratic forms, and deduced from this the whole theory of solution and the theory of eigenvalues of integral equations. Hilbert's theory of infinite bilinear and quadratic forms provided also a very powerful method for the treatment of boundary value problems for ordinary and partial differential equations. A theory of infinite matrices and of principal-axes transformations was also developed which supplied the mathematical foundations for modern quantum mechanics. The geometry of Hilbertian space has been applied to formulate the generalised absolute differential calculus which includes Ricci's tensor calculus as a particular case.

Apart from Mathematics, functions of infinitely many variables have an important bearing on natural philosophy. If we consider a phenomenon as the effect of a finite number of causes, we are making only an abstraction because we are neglecting elements which are supposed to be very small compared to others which are taken to be preponderant. In this way we make only an approximative study of the phenomenon, for a full and complete study of which it would be necessary to pass from a finite to an infinite number of variables.

From a consideration of the variation problems, Volterra was led to 'functions of lines' which are now called "functionals". Functional analysis has developed along various lines corresponding to those of the theory of ordinary functions. It has penetrated deeply into the various branches of pure and applied mathematics. Everything concerning integral and integro-differential equations, investigations on functional spaces, the calculus of variations with its diverse applications in mathematical physics, questions involving effects of hereditary type—all these different subjects have now been unified in one general theory of functionals. Moreover, the functional method gives us a ready criterion for examining whether the various expressions for natural laws are in an invariant form agreeing with modern relativistic conceptions.

Recently, a general analysis has been developed in which the concrete variables of the infinitesimal calculus have been discarded, and

relations are studied between two elements of any nature whatsoever. This new analysis proceeds by making an abstraction of all those concepts which are common to several known and allied theories. These are then generalised by removing from them any particular properties that are related to the concrete elements on which they are based. This has given rise to the general theory of "functional operators" which has now become an essential part of many of the most important domains of mathematics. In it we see the methods of classical mathematics blending harmoniously with those of modern mathematics, bringing about a certain unity in different branches sufficiently remote from each other. A really profound insight into many important branches of mathematics such as the theory of functions, integral and integro-differential equations, calculus of variations, theory of sets, topology and theory of dimensions is possible only with the help of functional operators.

Modern theories of physics make much use of the operator calculus. Thus, apart from classical mechanics and electro-dynamics, the subject of quantum mechanics in its modern developments is based entirely on the theory of linear operators. This theory plays the same part in quantum mechanics as tensor analysis plays in relativity mechanics. Quite recently the quaternionic operators have been applied to relativistic quantum mechanics.

Functional analysis has developed extensively during the last few years, and has penetrated deeply into mathematics, mechanics, mathematical physics, statistics, biology and sociology. It is one of the most powerful tools of research in contemporary mathematics.

6

BOTANY

President: Dr. S. Ranjan

THE RESPIRATION OF PLANTS IN LIGHT

In the case of non-green leaves of croton containing carotinoid pigments and the flowers of *Bougainvillea* and *Nerium*, the respiration rate in light appreciably increases. The respiration rate of a green leaf in light also increases, but due to photosynthesis the respiration rate is to a greater or lesser degree marked. Therefore to find out the true rate of respiration of a green leaf in light is to study the dark respiration after a period of illumination. The respiration rate of this dark period at first increases up to a point and then decreases. If this falling curve is produced backwards to the point when light was cut off or to the zero hour of darkness, then the respiration curve of darkness will show an L-shaped fall. The high point touched at the zero hour of darkness is the respiration rate in light while in darkness the respiration rate steadily falls off. This steadily falling off respiration curve is similar to the "floating respiration" of Blackman which is nothing else but the "after effect" of light. The following scheme for light respiration is suggested.

Hydrolysis

Carbohydrates ——— n(Glucose)

Primary reaction (Photochemical or thermal)

2 Glucose + hv Glucosé + glucose

Secondary reaction (Thermal)

Glucosé + En ——— $2C_xH_nO_z$ + q

2 Glucose + q ——— Glucose + glucose

Glucosé + En ——— 2 $C_xH_nO_z$ + q

and so on.

N.B.—En = Engyme.

q = hV + the difference of the energy between $C_nH_{1..}O_n$ and $C_xH_nO_z$.

hV = is the photonic energy (h is Planck's constant, V the frequency of light).

The above scheme of reactions suggests at least two reactions involved in respiration.

(1) The primary reaction which is both thermal and photochemical and (2) Secondary reaction which is purely thermal. Further support is given to the above scheme of reactions by the work on the temperature effect upon respiration in light. It has been found that in the case of Eugenia leaves—which is a tropical plant—the maximum rise in the respiration rate in light is at 27° C. This increase decreases with higher or lower temperatures. Now, according to the above scheme let us suppose that in the chain of reactions A→B→C the first reaction, i.e., A to B is Photochemical and B to C chemical. The rate of B to C will depend upon the rate A to B.

In dark at 20° C. both A to B and B to C are slow and the rate of respiration is consequently slow. If light is given A to B gets accelerated while B to C remains slow. Thus the reaction is limited by the rate of B to C.

At 27° C. the rate of respiration augments in light because B to C is no longer limiting.

Now as the activation of the reacting metabolites in the primary process can be brought about both by light and temperature, then if the temperature is greatly in excess a large number of molecules will already be in an activated state and with light the increase in activation will be proportionately less. Thus the increase in respiration proportionately decreases in light beyond 27° C.

The increase of the primary process or the increase of respiration in light will only take place, if the respiring organ is coloured. Colourless plants like fungi or the roots of plants show no increase in respiration in light, for the simple reason that light of the necessary frequency is not absorbed.

On this scheme the falling respiration curve of leaves which is called the floating respiration by Blackman is really the 'after effect' of light. Because the energy q given out in the reaction is enough to activate a second molecule of sugar and light energy after the first reaction, the value of hV will not be required. Theoretically the reaction once commenced in light shoud go on at the enhanced rate in darkness, but due to the gradual dissipation of energy q the respiration in darkness comes down to a slower rate.

8

ENTOMOLOGY

President: Y. RAMACHANDRA RAO

SOME OBSERVATIONS ON THE PERIODICITY OF LOCUST INVASIONS IN INDIA

IN the broadest sense of the word, a "Locust" is a grasshopper capable of appearing in large swarms and causing considerable damage to crops. While there is little difference in general appearance and structure, the grasshopper lives a solitary life scattered in small numbers all over the area, whereas the locust tends to congregate together both in the younger stages as hopper bands and in the adult condition as flying swarms.

There are three most important locust species in India: (i) the Migratory locust; (ii) the Bombay locust; and (iii) the Desert locust. The first is found in its solitary phase all over India; but there are indications that it can occasionally assume gregarious habits and become a destructive pest; the second is endemic in the region of the Western Ghats and usually visits the neighbouring districts of the Bombay Presidency. Its swarms invade also, Kathiawar, Central India, Central Provinces and parts of Madras and sometimes extend as far as U.P., Bihar and Bengal. Since 1910 this locust has not, however, occurred in a serious form. The third is the locust *par excellence* of India and is usually found in the desert regions of N.W. India, but during years of mass multiplication, may invade, upto Assam in the East, and right up to the northern districts of Madras in the South. This species has the ability to pass through two or more generations in rapid succession in a single year and assume the dangerous swarming condition under favourable circumstances. As this species has been the subject of special investigations in India since 1930, much information has been gathered in respect of its periodicity and various other factors.

When locusts appear they are seen at the same time in many parts of India either breeding or migrating, the extent of spread being considerably greater in years of high multiplication; during the intervals between locust cycles, few locusts are noticeable anywhere in India. During the recent swarm-free period, 1932–39, investigations financed by the Imperial Council of Agricultural Research, were in progress, regarding mainly, the habits, ecology and distribution of the nongregarious locusts found in the desert areas; these locusts are found to react to changes in the environment exactly in the same way as the gregaria phase locust; their breeding is similarly dependent on favourable rainfall and they migrate over long distances at the change of seasons from one rain belt to another and goes through at least two generations a year, one in winter-rain areas and the other in summer-rain areas. The main difference would appear to lie in the crowded life lived by the gregaria locust and in the high intensification of its activities under the influence of mass psychology. In the present state of our knowledge the change in status of an apparently innocuous, obscure, and sparsely distributed resident locust of the desert, into a highly dreaded pest, capable of appearing in vast hordes and dealing wholesale destruction to crops, would appear to be due mostly to its reaction to a complex of meteorological factors favouring its breeding under crowded condition.

The general sequence of events during a year of locust swarm activity may be roughly classified under (1) over-wintering, (2) spring breeding, (3) summer breeding. And the causes for the breakdown of the infestations are most probably, (1) failure of the swarms produced in the eastern areas in summer to reach the winter-rain zone and (2) failure, or very low seasonal rainfall tending to diminish greatly the extent of breeding and multiplication.

In the study of the ecology of the solitary phase, the main problem is to determine the conditions in which groups of solitary individuals become transformed into gregarious swarms. Since eggs are generally laid under crowded condition, the hoppers hatching therefrom, tend to get crowded and form incipient hopper bands later developing into the primary swarms of fliers. Such situations as these where phase transformation is brought about, are termed "outbreak centres".

The sequence of events in the origin of a locust cycle appear to be (1) heavy and well-distributed rainfall in the winter-rain areas causing the formation of outbreak centres with incipient swarms; (2) the conveyance of these swarms into the desert area at the right time for monsoon breeding; (3) occurrence of heavy and well-distributed monsoon bringing about concentrated and continuous breeding in the desert leading to the building up of large swarms.

The importance of taking adequate and timely measures in checking the initial outbreaks cannot be overemphasised. The best way of dealing with them would be to locate the centres of outbreaks and destroy the incipient bands of hoppers before they develop wings and leave the area.

The influence of the fluctuation of sunspot activity on locust incidence has been recognised by many authorities and this phase of locust investigation comprises a fascinating study.

Although a considerable advance has been made in a study of locust epidemiology there are still various gaps in our knowledge of locusts, especially in regard to problems of a fundamental nature and it is hoped that necessary funds for their investigation, while the material for study is available during the present swarm period, will be forthcoming.

12

PHYSIOLOGY

President: DR. B. B. DIKSHIT

SCIENTIFIC STUDY OF SLEEP

IN his Presidential address delivered before the "Physiology Section" of the 28th session of the Indian Science Congress held at Benares in January 1941, Dr. B. B. Dikshit, PH.D., M.R.C.P., M.B.B.S., D.P.H., records "Some observations on sleep" in the hope that his observations may urge young physiologists to pursue investigations of the familiar but, in some respects, baffling phenomenon of sleep. He notes that "most of the literature on sleep is in German, some in French and comparatively little in English" (P-2). In the opening section, Dr. Dikshit sums up a few observations on the physiological changes in sleep with reference to circulation, respiration, muscular movements and secretion of sweat. That sleep is a "parasympathetic phenomenon" is next noted. Sir Henry Dale had pointed out in 1934 that there is an intimate relation between parasympathetic and acetylcholine. If so, the question has to be posed and problem solved whether "acetylcholine is the sleep-producing hormone". Dr. Dikshit then briefly refers to the "Chemical theory of sleep", to "sleep centre" localized and identified in the third ventricle of the brain, to "cortical" and "sub-cortical" theories of sleep, and enumerates certain experiments conducted with a view to identification of the substances that act as sleep-producing hormones. Dr. Dikshit inclines to the view that a majority of considerations would point to *acetylcholine* being pre-eminently the sleep-engendering hormone. What is the action of acetylcholine on sleep-centre? Does it exist normally in the brain? Is there a special mechanism to control its action? Does its pharmacological action agree with the physiological changes observed during sleep? Is there accumulation of it in the sleep centre? These and allied questions are answered next and the concluding section is devoted to a discussion of methodological procedure and results obtained so far. Three important conclusions emerge from Dr. Dikshit's presidential pronouncement: (1) The sub-cortical centres are responsible for sleep. (2) There is a sleep-centre in the hypothalamic region. (3) Acetylcholine may be claimed to be a sleep-producing hormone and it activates the sleep-centre.

It may not be out of place, nor would it require any special pleading to observe that papers and presidential pronouncements, wherever possible of the Indian Science Congress, and of its different sectional ramifications, should occasionally at least endeavour to examine theories put forward in ancient Indian classics. The phenomenon of sleep affords undoubtedly the most fascinating subject of investigation, and Dr. Dikshit may have briefly surveyed the ancient Indian theories ignoring the fact that they of course were not formulations arrived after experimental investigation and laboratory analysis of the type now available. The Upanishadic theory of sleep may perhaps supply the clue to modern experimentalists. In the acute analysis of the state of sleep, perfect, undisturbed and dreamless sleep (*sushupti*) the Upanishadic thinkers have pointed out that the cortical centres are as much responsible for sleep as the sub-cortical so that for any theory or hypothesis to be complete, comprehensive, and inclusive of all the known facts and data, inclusion of both cortical and sub-cortical influences would be indispensable to account for sleep. That sleep is a parasympathetic phenomenon had been quite clearly realized by the Upanishadic thinkers. In their analysis, they pointed out that the entire *tout ensemble* of sensory-motor mechanism remains suspended during the time of sleep. (*Jnyana-karmendriya-uparati.*) But, then, only the *Chitta* is still active which renders possible personel identity and continuity of self-consciousness—such as "I had a sound sleep up till now". I wish Dr. Dikshit had made some brief reference to the theories of sleep advanced by the Ayurvedic teachers.

To many a teacher who is day in and day out confronted with the phenomenon of pupils falling asleep even during the first hour of the day undoubtedly as the result of a hurried meal and walking to the class-room, the problem of sleep must appear intriguing. On the contrary hundreds of students have complained to me that the soporific accents in which learned professors endlessly go on reading from the printed pages even without caring to face the audience straight, have invariably induced sleep in them however eager they might have been to "learn".

Is sleep at all necessary as a physiological necessity? The Yoga system has prescribed courses of practices by means of which sleep can be controlled. Certain practices lead to insomnia. To counteract it, other practices are detailed which plunge the subject in the bliss of deep, dreamless sleep. The ancient Indian thinkers had perfectly realized the value of sleep as a tissue-building reconstructive tonic.

The problem of sleep is by no means restricted to physiological treatment. It is psychological and its frontiers touch general philosophy. The Upanishadic thinkers saw that waking, dreaming, and sleeping should be viewed as triune or tripartite, so that abnormalities in one invariably found reflections and repurcussions in the other two. These problems deserve careful investigation. I commend Dr. Dikshit's address as an eminently able survey of the latest literature and theories on the problem of sleep.

R. NAGA RAJA SARMA.

13

PSYCHOLOGY

President: DR. I. LATIFF

PSYCHOLOGY AND THE FUTURE OF MANKIND

"THERE are only two alternatives: it is either re-education of man, or the catastrophy of his cataclysmic extinction. This presents to psychology its present task." In this rather alarmistic and challenging manner Dr. I. Latiff,

M.A., PH.D., concludes his address delivered as President of the Section of Psychology and Educational Science of the 28th session of the Indian Science Congress held at Benares in January 1941. In the opening section, Dr. Latiff refers to the "tragedy that attends the march of human affairs", and records in pathetic strains that "mental disorders, crimes, political unrest, wars and unhappiness dog its steps at every turn" (P-3). In the second section, he complains that the "leading intellectuals" are ignorant of the real causes of these disorders. Quoting fairly extensively from the work of Samuel D. Schmalhausen, he points out that man's behaviour should be studied from the standpoints of psychology and psychiatry and not from those of sciences like economics. Incidentally he observes that the hostility to psychology should be directly due to many a skeleton in the cupboard of the mental-make of these distinguished modernists. In the *third*, Dr. Latiff goes on to explain that notwithstanding the claims and achievements of modern civilized man, there exists "behind the facade of rational conduct, a primitive mental structure which regulates his individual and social life" (P-8), and which is perhaps responsible for the manifold maladjustments of mankind. That the existence of the primitive savage elements in modern civilized mankind is not realized on account of Repression, and Projection, and that conventional morality and religion are nothing but neurotic manifestations are explained in the *fourth*. In the *fifth* concluding section, a strong plea is entered for the use of scientific psychology in effecting mental and emotional re-adjustments imminently incumbent on human society to-day. How can scientific psychology help? Firstly, instinctual demands should be gratified within reasonable limits without the imposition of irrational restraints. Secondly, Psycho-analytic treatment should be made available more generally than at present. The work, thirdly, must begin in the nursery. Psychological clinics for children should be started. Fourthly, parents and teachers should be educated along the lines of scientific psychology. Fifthly, carefully graded sex-education to suit the psycho-sexual development of individuals should be imparted. Finally, as vocation is influenced by unconscious motives, psychology and psycho-analysis should be pressed into service in selection of vocation.

I have fairly carefully perused the 25 pages of closely printed matter of Dr. Latiff's Presidential address, and I feel like old Khayyam that I have come out by the same door as in I went trite as the comment may seem. In the interests of disinterested scientific investigation it must be emphasized that as between non-recognition of the value and significance of psychology and psycho-analytic technique in the colossal task of re-education of mankind, and overdoing and making a fetish of psychology, psychiatry, and psycho-analysis, the latter is undoubtedly more dangerous. A million Freuds notwithstanding Religion cannot be so easily dismissed as an evolutionary manifestation of infantile or savage FEAR. Be that as it may, the manifold miseries and maladjustments to which modern mankind has fallen a prey, are not after all so much due to occasional eruption into consciousness of hidden primitive motives and instincts, as actually to very visible and manifest tendencies. Dr. Latiff makes mention of the well-known sadistic and masochistic tendencies, and I wonder what reception would be accorded to the psycho-analytic explanation or hypothesis if Dr. Latiff were to argue that Mr. Gandhi's *fasts* are mere manifestations of masochistic tendencies seeing that fasts are certainly a species of ascetic self-torture.

That is why Indian psychology while emphasizing the value of deep-seated tendencies, dispositions, complexes, primitive instinctual desires and motives (designated by the all-comprehensive *samskara*) rightly insists on an adequate analysis of openly expressed behaviorism and overtly operating motives and springs of action. Thus, there is absolutely no need for an onlooker like Wendell Willkie to attempt the impossible task of psycho-analysing the Fuehrer for isolating and identifying the war-guilt!! Overt behaviourism must quite suffice. Formation and crystallization of opinion cannot be arrested when one finds that a strong military nation simply because it is strong and powerful invades its weak neighbour. That must kindle the righteous indignation of all without any otiose and unprofitable attempt at psycho-analysis of the aggressor.

It is all so easy to talk of educating the parent and the teacher on the lines of scientific psychology. But, who is to educate the psychologist and the psycho-analyst? Can he like the King do no wrong? Of course these and allied questions genuinely germane to the subject selected by Dr. Latiff are not even touched on, but, that need not prevent one from commending Dr. Latiff's address as a fine performance.

R. NAGA RAJA SARMA.

14

ENGINEERING

President: DR. C. C. INGLIS

HYDRODYNAMIC MODELS AS AN AID TO ENGINEERING SKILL

SOME hydrodynamic models give accurate results, others yield results widely diverging from those of the prototype.

Geometrically similar models constructed for determining coefficients of discharge, standing wave relations, study of lines of flow at off-takes, and scour downstream of falls yield results with a fair degree of accuracy. But experiments conducted at Poona, on geometrically similar models to determine the coefficients of a high coefficient weir and to study the slab movement in the submersible bridges have not yielded similar results.

Usefulness of models with a mobile bed is well exemplified in the experiments on the flow round a bridge pier constructed in erodible sand in which "flow pattern" is the dominant factor. In 1938–39 Annual Report of the Central Irrigation and Hydrodynamic Research Station, it

is shown that scour, at pier noses, is due to the water, diverted by the pier, diving downwards towards the upstream toe of the pier. The action of scour is due to the 'flow pattern' and is scarcely affected by the upstream bed level.

Rigid vertically-exaggerated models, though with great care may be made to reproduce correctly conditions for a given discharge, may fail with longer or smaller discharges. Much patient 'trial and error' work spread over a number of years along with large data may enable prediction of conditions outside the verified range. But direct informations about scour and consequent changes in flow cannot be got. A rigid model of a 20-mile length of the Hoogly above Calcutta is being studied at Poona to determine lines of flow and places of scour bed action, as preliminary, to a more exhaustive investigation of bank-scour problem with semi-rigid or mobile part-models, using larger discharges.

Semi-rigid models can reproduce similarity much more accurately than the whole mobile models. But throughout the length of the channel conditions are imposed, the model being incapable of scour, its banks being rigid or changing its course thus precluding studies of future changes of river course and their consequent effects.

In the case of mobile channels, as a result of Lacey equations, slope exaggeration must equal vertical exaggeration for the same silt factor in model and prototype. A coarser silt increases the slope exaggeration whereas it decreases the vertical exaggeration. Choosing of correct silt conditions in a model is thus very essential. Hence channels can be more satisfactorily designed by the use of formulæ than by model studies.

Silt movement and hence the amount of scour and silting are always relatively much less, in a natural mobile model than in its prototype. With a low discharge, silt movement will occur in rivers whereas in a model it will not commence till a flow is a considerable fraction of the flood discharge. Use of finer silt in models though increases silt charge, has little effect on the velocity at which silt movement begins and ends. In the 1/300 Sukkur Barrage model, when regulated as at the Barrage, silt movement does not begin till the discharge exceeds half the normal maximum flood discharge. In many river problems, scour after floods greatly affects subsequent flow conditions and this scour is not correctly reproduced in models, leaving us to depend either on experience and judgment or to distort the model scales to effect silt movement at low discharges.

Bank slopes and rigid structures are exaggerated according to the depth exaggeration scale. Such exaggeration fails to reproduce correctly the "flow pattern" thus necessitating recourse to large-scale part-models, essential for studying bank effect.

To prevent distortion in plan, models are foreshortened longitudinally in the ratio of the vertical exaggeration, this foreshortening leading generally to distortion of the lines of flow or eddy pattern, due to inadequate length.

Long and short river models have specific advantages but in both these cases, great care must be bestowed on entry condition as on its correctness depends a reliable reproduction of the meandering course of a river. Generally models varying from geometrical similarity to various scales of vertical exaggeration would be needed to help proper understanding.

For several years, various scale experiments have been conducted with mobile models at Poona, to study effects of variation of slope scales, discharge scales, silt charge and vertical exaggeration. They have indicated the limitations of river model studies; a wide range of experiments with large models generally yield highly accurate qualitative results with some measure of quantitative accuracy. Conditions that have existed in the prototype under a known discharge and silt charge, can be reproduced accurately in a model and at best, mobile river model can serve as a valuable guide to the engineer.

C. GOPALAKRISHNAN.

CENTENARIES

Cooper, Astley Paston (1768–1841)

ASTLEY PASTON COOPER, a British surgeon, was born at Brooke Hall about seven miles from Norwich 23 August 1768. His father was a vicar; but his grandfather and uncle were both surgeons. He passed a spirited boyhood without much schooling. He learned classics from his father and his mother, who was an authoress of no mean repute, taught him history and grammar. He was thus neither overtaught nor overstrained in his boyhood. When he completed his sixteenth year, he was apprenticed to his uncle, surgeon to Guy's Hospital, and later to Henry Cline, surgeon to St. Thomas's Hospital. He specialised in anatomy and completed his course by spending seven months in Edinburgh, in close association with the most renowned surgeons of that place.

In 1789 Cooper was appointed demonstrator of anatomy at St. Thomas's Hospital and two years later he was promoted lecturer. He followed the Hunterian model which was scoffed at by the elders. The students accustomed to the teaching of such scoffers began to desert Cooper. After investigation Cooper found that it was due to their ignorance of Hunterian terminology and their lack of experience. To counteract these difficulties, Cooper adopted the plan of bringing before the class cases of disease and injury and further illustrating by morbid specimens and experimental results. This method he practised with great success throughout his teaching career of forty years.

In 1800 Cooper was appointed surgeon to the Guy's Hospital. In 1805 he took an important part in founding the Medico-Chirurgical Society. Its *Transactions* contains several contributions by him. His two volumes on *Hernia* (1804–1807) are justly famous. In 1822 Cooper brought out his well-known *Dislocations and fractures of the joints*. In 1827, he became President of the College of Surgeons and in the next year he was appointed surgeon to the King.

In 1820 Cooper operated upon King George IV for a tumour of the scalp. This brought him a baronetcy. An anecdote connected with this operation shows the change in surgical practice that has come since those times. Cooper was summoned hurriedly to the Palace one evening. On his return he asked Bransby Cooper, his nephew, "Pray tell me, do you see anything particular about me, for the King did not seem in good tune; he looked very hard at me from head to foot, and I cannot understand why—do you see anything?" "Why" said Bransby, "I should have put on a white cravat and a clean shirt, or at least have washed my hands before I waited on His Majesty." The fact is, Sir Astley had performed a slight operation just before he went to the Palace, by which some blood had stained the sleeve of his shirt where it projected at the wrist, and his hands also were not perfectly free from it. Mr. Cooper then looking at what he had pointed out to him said "God bless me, so I ought, but I was not aware of it. The King, sir, is a very particular person; he was lying on a couch under a canopy with a red turban on his head, and he looked displeased and now I see the reason of it."

A statue of Cooper was erected in St. Paul's Cathedral. He died 12 February 1841.

Gregory, Olinthus Gilbert (1774–1841)

OLINTHUS GILBERT GREGORY, a British mathematician, was born of humble parents at Yaxley 29 January 1774. After studying in the village school, he learned Mathematics from Richard Weston, a botanist, with such good effect that as early as 1793 he published a small book of *Lessons, astronomical and philosophical*. He also wrote a book on the slide rule, which brought him to the notice of Charles Hutton, professor of mathematics at the Royal Military Academy at Woolwich.

In 1796 he settled as a bookseller in Cambridge and gave private tuition in mathematics. The latter occupation soon became so profitable that he gave up the bookselling business. In 1802 he was appointed mathematical master at the Royal Military Acadamy; and he became professor on Hutton's resignation in 1807.

He obtained honorary degrees from several institutions and became a fellow of the Royal Society. He was one of the original founders of the Royal Astronomical Society and one of the projectors of the University College, London. His name was inscribed in the foundation-stone of that college laid in Gower street, 30 April 1827.

He was a prolific writer. His *Treatise in astronomy* (1802), his *Treatise of mechanics*, 3v. (1806) and the *Elements of plane and spherical trigonometry* are the most well known. His works are characterised by sound knowledge, good arrangement and clearness of exposition.

Gregory died 2 February 1841.

S. R. RANGANATHAN.

University Library,
Madras.

SCIENCE NOTES AND NEWS

An Optical Hygrometer.—Dr. L. D. Mahajan, Physics Research Laboratory, Mahendra College, Patiala writes:—

An optical hygrometer has been devised in this laboratory in order to study the variation in the humidity of the air.

To a zinc rod (balance beam), about 1 mm. thick and 10 cms. long, a cup of zinc of 1 cm. square and 2 mms. deep is fixed rigidly to each end. In the middle of the beam, a revolving rod of copper, about 1 mm. thick and 7 mms. long, is rigidly attached at right angles to it. A small spherical mirror of about 2 metres focal length is fixed to the revolving rod, just on one side of the junction of the revolving rod and the balance beam.

The two ends of the revolving rod are made to rest on two fine, well polished and equally levelled glass plates fitted on a stand. One of the cups is filled with a powder containing about 97 per cent. Plaster of Paris and 3 per cent. calcium chloride. It has been found by various trials and observations that the mixture of these two powders has high power of absorption and desorption of moisture. Suitable weights are added into the other pan till the beam is almost horizontal.

A beam of light is thrown from a lamp and scale arrangement on the spherical mirror and the reflected beam is allowed to fall somewhere in the middle of a vertical scale at a distance of about 200 cms. from the revolving instrument. The whole instrument is placed inside a rectangular glass vessel perforated with holes at the base to permit free circulation of air inside it and to avoid any disturbance to the revolving arrangement due to any direct and strong currents of air. Then the instrument is ready for measurements.

With a small change in the humidity of the air, the spot of light moves through a great distance on the vertical scale. The shift of the spot of light is proportional to the change in the relative humidity of the air.

The author is indebted to His Highness' Government, Patiala, for having provided facilities to carry out this work in the Physics Research Laboratory, Mahendra College, Patiala.

December 21, 1940.

Archaeological Discoveries in U.P.—Important discoveries which might help in filling up the gaps in India's ancient history are expected to be made at Ramnagar in the Bareilly District of the United Provinces. The site has been identified as the city of Ahichchatra, the capital of ancient Panchala, which corresponds roughly to the modern Rohilkhand Division. The city is on an elevated triangular tableland of rolling mounds, covered with thick layers of bricks and potsherds, surrounded by a broad brick wall, rising in places to nearly 50 feet above the low plain outside. The wall shows bastions and angles at various points and is nearly three-and-a-half miles in circuit. The bricks used in the wall are unusually large, being 21 to 24 inches long, indicating an early age, from 100–300 B.C.

Except for a rapid survey, nearly 70 years ago, by General Sir Alexander Cunningham, the first Director-General of Archæology, the site at Ramnagar has received no attention from the Archæological Department. The present discovery ensued from a recently undertaken survey of promising ancient sites in the western United Provinces and systematic excavation is in progress under the direct supervision of the Director-General of Archæology.

Two high mounds, 30 to 50 feet high, stand inside the city and seem to be the remains of terraced temples, but there is nothing in the configuration of the mounds to distinguish different parts of the ancient city. A broad partition wall appears to run from north to south dividing the city into two unequal parts, the eastern one being smaller than the western. Excavations are in progress in the western part, over an area of about 350 feet each way, where several houses, lanes and streets have been brought to light.

The temples and houses of the city that has been exposed so far appear to belong to the epoch of the Gupta Empire — 400–500 A.D.— and there is little doubt that the ancient capital was evacuated sometime about the Hun invasions of the fifth century A.D. The city must have been in existence for nearly a thousand years before desertion.

As excavation proceeds layer by layer earlier occupations will reveal themselves. It is also proposed to dig trial trenches in an isolated mound in the eastern part of the city. This area, it is believed, was abandoned at an earlier period, sometime in the early centuries of A.D. and earlier settlements may be expected to be found nearer the surface there than in the western area.

The Stone Implements of Bandarawela, Ceylon.—N. A. Noone and H. V. V. Noone made a large collection of mesolithic-like stone artifacts in the vicinity of Bandarawela, and has described them in the *Ceylon Journal of Science* (Section G. Anthropology, Vol. III, part 1). The tools are mostly of quartz, and their occurrence has been reported by previous workers particularly, the Sarasins, Hartley and Wayland, but the present authors go into the details of the technique and classification. In the absence of stratigraphic evidence, no definite dating of the culture is possible, but for convenience the authors have designated it "Bandarawelian". The authors appear, however, to be not aware of the work done in central India, and of the occurrence of an almost similar culture in Tinneveily. Quartz implements of very interesting and comparable types have been discovered in the Nellore District of the Madras Presidency by Dr. Frank P. Manley (*Curr. Sci.*, April 1940). The fresh data from Ceylon will thus be of great interest to prehistorians in India.

Glassfish Nutrition.—Mr. T. J. Job, Lady Tata Research Scholar, working in the Laboratories of the Zoological Survey of India, Calcutta, in the course of his investigations on larvicidal fishes, has made observations on Glassfish nutrition and its bearing on the control of malaria and guinea-worm. Food analyses, feeding experiments and field observations conducted by him in the 24-Perganas and in the malarious areas of the Hoogly Delta Section of the Bengal-Nagpur Railway, have revealed that (1) the mosquitocidal propensities of the Glassfishes (*Ambassis* Cuv. & Val.) are inferior to those of the Killifishes like *Aplocheilus* McClelland and *Oryzias* Jordan and Snyder, but that (2) the Glassfishes are remarkably effective in the destruction of cyclops in their natural environment. These observations are likely to prove of great value in the biological control of guinea-worm disease. Detailed results are in the course of preparation and will be published in due course.

Sizes of Plant Viruses.—Determination of sizes of viruses by the filterability and the ultracentrifuge methods have given, in a large number of cases, different values for the same virus. The discrepancy between the values obtained by these two independent methods, has now been traced to the circumstances that the viruses differ not only in size but also in shape. When the particles are spherical as in the case of the viruses of Tomato Bushy Stunt, Tobacco Necrosis and Tobacco Ringspot, the two methods give comparable values. The sizes of these viruses are respectively 27, 25 and 19 $m\mu$. In the case of particles which show anisotropy, our knowledge of the sizes is less accurate. The particles of the Tobacco Mosaic virus are known to be rod-shaped. The width of these particles as determined by different methods is in the neighbourhood of 13 $m\mu$. There is considerable variation in the estimates for the length of these bodies; for one thing, it is known that the virus particles can adhere end-to-end. Measurements with the electron microscope reveal that most of the particles in the infective sap have a length of 300 $m\mu$ while some others are only 150 $m\mu$ long.

Root-growth Promoting Substances and the Technique of their Use.—We may note that in India the use of the root-growth promoting substances like indole butyric acid, Indole acetic acid and similar compounds now being made

known largely by the work of the Boyce Thompson Institute for Plant Research in the U.S.A., has been studied very little and that no satisfactory results have been reported. The scope for vegetative propagation by the planting of cuttings is very great not only in the limited sphere of the plant breeder but also in the extensive field of commercial nursery and estate work. Its usefulness in the propagation of high yielding strains through seed which can be fixed and made to breed true only after successful breeding work carried out over many years is too obvious to be stressed; there is, in addition, in the case of multiplication the class of plants whose seedlings are too delicate and are subject to diseases attacking the roots and collar causing the death of innumerable seedlings in the early stages, like the clove, chincona and so on, and again the class of fruit plants in which earliness of fruiting resulting from vegetative propagation is a chief consideration in favour of the method.

The method of utilising these root-growth promoting substances is, however, not so simple as it may appear and many essential conditions have got to be worked out suitable both to the type of plants dealt with and the environmental factors that may prevail. Attention is pointedly drawn to these conditions by Henry Kirkpatrick Jr., in Professional Paper No. 30, Boyce Thompson Institute, for Plant Research, in regard to the rooting of evergreens. The conclusions of three years work bring out clearly the importance of a study of all these factors before success can be attained. It is stated, for instance, that cuttings of certain genera, such as cedrus and pinus, failed to respond altogether. Many limiting factors are indicated even in the case of plants which respond well; thus the time of the year at which the cuttings are taken, the type of cuttings used, the temperature of the propagating house and the rooting medium, the care of the cuttings during the rooting period and the strengths and methods of application of the substances—all are important controlling factors. The writer of this note can well appreciate this need for study of the factors before success can be had, as he attempted the method with a large number of different kinds of plants and tried as many as four different substances, *viz.*, Skatole, and three proprietory products called "Auxilin", "Seradix A" and "Hartomone", with none of these was any success worth mentioning obtained, nor any great difference noticed as against the controls, the conditions necessary for success under the local environmental, soils, seasons and the type of plants, the age of cuttings and so on not having evidently been worked out and known. We would strongly suggest this subject being taken up by plant breeders in India to a greater extent than at present.

A. K. Y.

Depth of Soil Sampling for Soil Analysis.—It is well known that the composition of soils in manurial experiments as determined in the usual manner of analysing six-inch depth samples does not disclose increases of nitrogen, phosphoric acid or potash where such increases would be expected as the result of fertiliser application, even when such applications are in doses far in excess of anything which may be thought of in practice on the field. In view of the fact that such increases can be expected much more in the top layers than those below, the desirability of analysing small-depth samples is coming to be recognised and considerable work has already been done on the subject elsewhere. In India the importance of small-depth samples is stressed as the result of work carried on in the Agricultural Research Institute, Nagpur (K. G. Joshi, in the *Nagpur Agr. Coll. Mag.*, 15, No. 1). Soil analysis in connection with certain manurial experiments on pasture land showed no significant differences in the composition of soils from manured and unmanured plots in soil samples of the usual six-inch depths. Small-depth samples were then decided upon and samples of every-inch-depth were then taken from the same manured and unmanured plots and analysed. Significant differences in both the phosphoric acid and nitrogen content were now noticed in top two one-inch sections and sometimes lower down also. Assuming the weight of soil per acre to a depth of six inches to be two million pounds, then the fertilisers added should be expected to show an increase of 0·012 per cent. of phosphoric acid, but the experimental error of 0·01 per cent. makes such increase not possible of detection. On the other hand the weight of an acre of soil only one inch deep will be only one-third million pounds and the increase due to manuring if concentrated in the top one-inch layer should be 0·07 per cent. which is much more than the experimental error and is easy of detection. The importance of taking small-depth samples is thus brought out—a matter which opens out very important possibilities in the interpretation of manurial experiments.

A. K. Y.

Paragonimiasis in China.—Paragonimiasis is a wide-spread disease in man and animals in China and H. T. Chen (*Lingnan Science Journal*, 1940, vol. 19, No. 4) has added considerably to our knowledge of this disease by his extensive studies on *Paragonimus iloktsuensis*. This species inhabits rats and its intermediate hosts are an amphibious snail, *Assiminea lutea* and two species of crabs, *Sesarma dehaani* and *S. sinensis*. The larval stages consist, as in other species, of miracidia, sporocysts, first and second generation of Rediæ, cercariæ and metacercariæ. Of these the metacercariæ are the most interesting. Their structure differs from the similar stages of other species. They have very thin walls and are easily broken, and are used as diagnostic features by the author for *P. iloktsuensis*. Experimental studies have shown that it is not possible to infect wild cats, pigs, guinea-pigs or monkeys with this species. A complete, profusely illustrated description of the anatomy and life-history of the species is given.

Coal Mines Stowing Board.—The *Annual Report* of the Coal Mines Stowing Board for the year 1939–40 which has been recently published, gives an account of the work done by the Board since its inception in November 1939. The principal function of this body constituted in accordance with the provisions of the Coal Mines Safety (Stowing) Act of 1939 passed by the Government of India is to administer a fund known as the Coal Mines Stowing Fund for meeting the expenses in connection with the administration and furtherance of the objects of the Act and with the grant of stowing materials and other assistance to owners, agents, or managers of coal mines. A brief account of the Jharia and Kusunda fires in February 1939 is given as an Appendix to the *Report* and is illustrated with several striking photographs (some in colour) of the fire areas, taken by Mr. V. P. Sondhi, of the Geological Survey of India. As the *Report* puts it, "no description in words can convey a clearer impression of the devastating activity of the fires than these photographic views".

Iron Ore Deposits of Bihar and Orissa.—Several questions arising out of a study of certain aspects of the formation and sequence of a group of rock strata known as the Iron Ore Series in the South Singhbhum area in Bihar have been clarified by Dr. J. A. Dunn, of the Geological Survey of India, in a brochure entitled "The Stratigraphy of South Singhbhum".

The publication deals mainly with the stratigraphical aspects of the area discussed but does not omit to touch upon the mineral deposits occurring therein. Dr. Dunn produces evidence to show that a regrouping of the area is necessary to distinguish the true Iron Ore Series occurring in the lower and older group of strata which contains the main iron ore deposits, from the relatively newer Kolhan Series occurring in the upper group of strata.

The upper or Kolhan Series comprises shales on top, limestones in the middle and sandstone conglomerates in the base which rest unconformably on the lower or real Iron Ore Series. The latter consist of phyllites, banded hematite-quartzites, tuffs, cherts and lavas. Dr. Dunn is, however, himself not quite satisfied that the detailed geological structure of the folded Iron Ore Series has been fully elucidated, but the change in sequence of the strata has led to a clearer understanding of the origin and distribution of the iron and manganese ore deposits.

In 1934 the Geological Survey of India issued a valuable contribution by Mr. H. Cecil Jones on "The Iron Ore Deposits of Bihar and Orissa" as a *Memoir*, Volume 63, Part 2. The brochure now issued is part 3 of that volume. Its author, Dr. Dunn had been early associated with Mr. Jones and has been long engaged on Geological investigations in Bihar and Orissa and is particularly qualified to deal with the subject.

Mysore Geological Department.—The latest number of the *Records of the Mysore Geological Department* (Vol. 38, 1939) begins with the Director's General Report for the year 1938–39 in which a detailed account is given of the administrative and scientific work done in the Department during the year. In connection with the scheme for the development of hydro-electric power at Jog, the Department made a detailed examination of the sites for the location of the Dam, Forebay, Penstock lines and Generating Station, and submitted the results to the Chief Electric Engineer. There are also a number of papers published in the *Records* embodying the work done by the officers of the Department mostly dealing with prospecting work for useful minerals like silica, asbestos, bauxite, etc., in the State. Special schemes for the preparation of chemical products such as sodium bichromate and potassium permanganate from the raw materials available in Mysore, are also under the active consideration of the Department.

Indian Central Jute Committee.—The importance of a technique which enables reliable spinning trials to be made on small samples of fibre, needs no emphasis. In work connected with the selection and breeding of improved strains of jute, the quantity of fibre available in the early stages of the development of a new variety is necessarily very small. To save the waste of time, labour and money which would be involved in carrying on the breeding of inferior varieties it is clearly desirable to be able to assess the quality of the fibre yielded by a new variety at the earliest possible stage. With this object in view the Technological Research Laboratories of the Indian Central Jute Committee have prepared a brochure describing the methods which have been worked out in the Laboratories for obtaining from small quantities of fibre a representative sample of yarn on which tests may be made that can be relied upon to give an indication of the quality of the fibre.

The brochure is called "Technological Research Memoir No. 1—A Technique for Spinning Yarn Samples from Small Quantities of Fibre". The technique described in this memoir is also adapted for comparing the effect on fibre quality of manurial treatments, soil conditions, rate of sowing, state of ripeness at which the jute is cut and so on. It is also suitable for purposes such as examining the results of variations in spinning procedure and batching treatment and for comparing the quality of the different positions of the fibre (top, middle and bottom). The method enables a spinning trial and yarn tests to be made if a quantity of fibre as small as 10 lb. is available, although for general purposes a rather greater quantity (20 to 40 lb.) is preferable. The technique involves no radical departure from mill practice, but calls for only certain minor modifications in it.

The Government of India have recently approved the scheme for the extension of the Technological Research Laboratory of the Indian Central Jute Committee for research work on the new uses of jute. For this purpose, they have provided, in the next year's budget,

a sum of Rs. 3,85,000 (non-recurring) and Rs. 10,000 to Rs. 40,000 (recurring). At its recent meeting held at Calcutta on 27–30 January, the Indian Central Jute Committee appointed a sub-committee of experts to recommend the equipment that would be required for the work.

At the same meeting, it was decided to carry out investigations on the use of jute sticks for preparing α-cellulose. Collaboration with the Forest Research Institute, Dehra Dun, was agreed upon for exploring the economic utilisation of jute waste in the manufacture of paper. A sub-committee consisting of Prof. M. N. Saha, F.R.S., Mr. C. R. Nodder and Dr. W. G. Macmillan was appointed to prepare a programme of research on the X-ray examination of jute.

Toxic Gases in Industry (The Detection of Organic Halide Compounds).—With the issue of No. 12—Organic Halogen Compounds (H.M. Stationery Office, price 2*d.*)—the Department of Scientific and Industrial Research completes its series of leaflets on methods for the detection of toxic gases in industry.

The wide use of organic halogen compounds as solvents and cleaning agents makes the occurrence of dangerous concentrations of the vapours possible in such industries as the artificial silk, bleaching and dyeing, dry cleaning, electro-plating, engineering, lithography rubber, etc. Ten of the commonest organic halogen compounds are dealt with, and the symptoms due to exposure to the vapours described. The effects are mainly narcotic, but tetrachloroethane, for example, is highly injurious to the liver.

The method of detection described is by the use of a form of blow lamp called the "Halide Detector Lamp" which burns pure alcohol in a supply of the air under test. The organic halide is decomposed, the corresponding copper halide is formed on a small copper screw in the nozzle of the lamp and, depending on the nature of the organic halide, the degree of green colouration in the flame indicates the concentration present. A table is given linking the appearance of the flame with concentrations of each of the ten halides. The exact procedure to be followed in using the lamp is described in the latter part of the leaflet. It must not be taken into an atmosphere containing inflammable vapours, and a special method of test is outlined for use when inflammable vapours are present.

Department of Chemical Technology, University of Bombay.—This progressive department of the University of Bombay is now issuing its annual report separately. Plans and estimates for new buildings for the Department at the rear of the Victoria Jubilee Technical Institute at Matunga have been approved by the Board of Visitors of the Department, the Syndicate and the Senate. The new buildings have been generously designed, with provision for future expansion, and special laboratories for micro-analysis, high pressure work, furnaces, air-conditioned tests, and an industrial museum. The Department has continued to maintain contact with the textile and other chemical industries of the Province, as evidenced by the employment of its graduates, the subsidies received for industrial research, and the increasing amount of analytical work and technical investigations submitted to the Department. A noteworthy feature is the provision of private endowments consisting of a Fellowship of Rs. 100 a month, and a subsidy of Rs. 100 per month to the Department towards the cost of materials, etc. The expenditure involved in the purchase or fabrication of any special equipment is also borne by the party concerned, whose sole property are the results of the investigation.

Manufacture of Fish Oils in India.—At the fourth meeting of the Medical Stores Supply Committee held in New Delhi on the 20th January, the Chairman, Lt.-General G. G. Jolly, Director-General, Indian Medical Service, revealed that a flourishing fish liver oil industry existed in the Madras Presidency eighty years ago. Apparently this flourishing concern was gradually killed by competition in prices.

Medicinal liver oil from the shark and saw-fish is once more being produced in Calicut. It is understood that efforts are also being made by the Governments of Bombay and Bengal and the State of Travancore to manufacture fish oils. Modern research has shown that the use of shark and saw-fish liver oils as a substitute for cod liver oil is sound practice, since the former are considerably richer in Vitamin A than cod liver oil.

A modern industry engaged in the production of medicinal fish liver oil enjoys the advantage that scientific methods for testing and standardising such oil are available. Investigations about the vitamin content of oil in the *Nutrition Research Laboratories*, Coonoor and other laboratories have played an important part in recent developments.

Manufacture of Paper in India.—The production of paper in India followed a steep rising trend during 1939–40. It amounted to 1,416,000 cwt. as compared with 1,184,000 cwt. in the preceding year and 1,076,000 cwt. in 1937–38. There were altogether thirteen mills in operation during the year.

The dislocation of trade with the Scandinavian countries and the consequent reduction in imports of paper gave the industry a respite from foreign competition and although costs of materials increased along with the prices of paper, the situation still left a substantial balance of advantage in favour of the industry.

Mechanical newsprint, which used to be imported mainly from the Scandinavian countries and which is not made in India, could still be obtained from alternative sources such as Canada and the United States of America, but there was a large variety of other papers including fine papers for which consumers have now to depend entirely on Indian mills. Some of them were never produced in India and it is possible that there may be a serious shortage of such varieties till Indian mills are able to produce suitable substitutes for them.

Imperial Agricultural Research Institute.—MR. P. L. CHATURVEDI has been awarded the Diploma of the Institute (Assoc. I.A.R.I.) after the completion of two-year post-graduate course in Entomology commencing from November 1938, and the acceptance, by the Institute Council, of his thesis under the title of "Biology of *Melanagromyza Phaseoli* Coq".

The appointment of **Prof. J. N. Ray** as Director of Production, Drugs and Dressings, has been gazetted. Laboratory facilities have been provided for him at the Imperial Agricultural Research Institute, New Delhi.

Royal Asiatic Society of Bengal.—At the annual meeting of the society held on 3rd February at Calcutta, the following gentlemen were elected office-bearers for the year 1941:—
President: The Hon'ble Mr. Justice Lort-Williams, KT., K.C.
Vice-Presidents: Bt.-Col. Sir R. N. Chopra, Dr. C. S. Fox, Dr. Syamaprasad Mookerjee and Sir S. Radhakrishnan.
General Secretary: Dr. B. S. Guha.
Treasurer: Dr. Baini Prashad.

The Sir William Jones Memorial Medal has been awarded to **Sir P. C. Ray** in appreciation of his researches in science. The award is made triennially out of an endowment fund created in 1926 by Sir U. N. Brahmachari in memory of Sir William Jones, the founder of the Society.

The Indian Botanical Society.—As a result of elections held at the Twentieth Annual Meeting of the Indian Botanical Society at Benares on the 3rd January 1941, the Executive Council was constituted as follows:—
President: Prof. S. L. Ghose (Lahore); *Vice-Presidents*: Dr. H. Chaudhuri (Lahore), and Dr. Shri Ranjan (Allahabad); *Secretary*: Prof. Y. Bharadwaja (Benares); *Treasurer*: Prof. M. O. P. Iyengar (Madras).
Elected Members of the Executive Council: Dr. P. L. Anand (Lahore), Dr. K. Biswas (Calcutta), Dr. Rafique A. Khan (Aligarh), Dr. B. C. Kundu (Calcutta), Rai Bahadur Prof. K. C. Mehta (Agra), Dr. R. L. Nirula (Nagpur), Dr. B. P. Pal (New Delhi), Principal P. Parija (Cuttack), Prof. B. Sahni (Lucknow) and Rai Sahib Kalidas Sawhney (Parbhani-Deccan).

University of Mysore, *January* 1941.—The results of the Medical Examination held in December 1940 were published. They were as follows:—

I. Examination:

		Examined	Passed
1.	Pre-medical	29	20
2.	First M.B.B.S.	30	17
3.	Second do. Pt. I	20	15
	Do. Pt. II	16	12
	Do. Pt. III	16	5
4.	Final M.B.B.S.	29	10

II. University Extension Lectures.—Dastur Dr. M. N. Dhalla, M.A., PH.D., LITT.D., High Priest of the Parsees of Karachi and Sind, delivered a lecture at Mysore on "Our Indo-Iranian Heritage".

The Hilger Abridged Spectrophotometer.—Leaflet SB. 289 (August 1940) of **Adam Hilger** Ltd., describes a simple instrument for approximate spectrophotometric analysis and for investigating colour differences. With a set of light filters mounted on a slide in the eye-piece, and a polarising lamina, a series of measurements can be made of the variation of reflection factor throughout the visible spectrum, thus providing valuable information as to the nature of any colouring matter, or of any discolouration, adulteration, or other quality of the material. The instrument is very suitable for carrying out rapid spectrophotometric tests of an explanatory character or for spectrophotometric measurements in which the highest accuracy is not essential. It is applicable to a variety of coloured materials such as Printing Inks, Textiles, Plastics, Prepared Foodstuffs, Paper and Leather Goods. For materials which are nearly white in colour, such as flour, chemicals and paper, an enhancement of the photometric sensitivity can be obtained by attaching to the 'Colour Comparator' a "Hilger Photometric Amplifier", which employs the principle of multiple reflection to increase the apparent selecetive absorption.

A New Photo-Electric Colorimeter.—The need for a really efficient Photo-electric Colorimeter has long been felt. The Klett Manufacturing Co., of New York, after years of research work, have placed in the market such an instrument in the name of Klett-Summerson Photo-electric Colorimeter.

The development of the Photo-electric Colorimeter provides the scientists with an inexpensive instrument to make colour determinations entirely by electrical methods.

The instrument is easy to operate. It is entirely self-contained and is run directly from the electric mains supply.

It is suitable for the determination of blood sugar, urea, creatinine, uric acid, vitamin C in blood, iron, copper, etc. Readings can be taken with as little as 5 c.c. of liquid.

Particulars are available from Messrs. **The Scientific Instrument Co. Ltd.**, 5A, Albert Road, Allahabad.

SEISMOLOGICAL NOTES

During the month of January 1941, five moderate and six slight earthquake shocks were recorded by the Colaba seismographs as against three moderate and three slight ones recorded during the same month in 1940. Details for January 1941 are given in the following table:—

Date	Intensity of the shock	Time of origin I.S.T.		Epicentral distance from Bombay	Co-ordinates of the epicentre (tentative)	Depth of focus	Remarks
1941		H.	M.	(Miles)		(Miles)	
January 2	Slight	22	20	3100			
4	Slight	08	43	3750			
6	Moderate	00	17	3420	Near 6° N., 123° E., to the South of the Philippine Islands		
10	Slight	13	08	1070			
11	Moderate	14	02	1930	Near 16°·5 N., 43°·5 E. in Yemen in Arabia		
12	Slight	15	47	870			
13	Moderate	21	58	5650	Near 0°·5 S., 154°·0 E., to the North of New Ireland		Damages to buildings reported in Por Rabaul in New Britain
21	Moderate	18	12	1350	Near 27°·5N., 92°·5E., to the North of Assam.		Felt strongly at Shillong and mildly at Sylhet, Silchar and Gauhati
27	Moderate	08	00	1430	Near 28° N., 93° E., in Tibet to the North of Assam		
30	Slight	14	45	1480			
31	Slight	08	09	3910			

MAGNETIC NOTES

January 1941 was magnetically less disturbed than the previous month. There were 9 *quiet* days, 20 days of *slight* disturbance and 2 of *moderate* disturbance as against 4 quiet days, 21 days of slight disturbance, 4 of moderate disturbance and 2 of great disturbance during January 1940. The day of largest disturbance during January 1941 was the 17th when a moderate storm was in progress, while that of least disturbance was the 14th. Classification of individual days are shown below.

Quiet days	Disturbed days	
	Slight	Moderate
4, 11–15, 28, 29, 31.	1–3, 5–10, 18–27, 30.	16, 17

During the month one moderate magnetic storm was recorded as against four storms (two of moderate intensity and two of great intensity) during January last year. The monthly mean character figure for the month is 0·77 while that for January 1940 was 1·06.

M. R. RANGASWAMI.

ASTRONOMICAL NOTES

The Sun will be at the vernal equinox on March 21, 1941, at $5^h\ 30^m$ a.m. I.S.T.

Eclipses.—Two eclipses will occur during the month; one of them is a partial eclipse of the Moon on March 13, 1941. The ending alone will be visible in the eastern parts of India, the Moon leaving umbra at 6-26 p.m. The other is an annular eclipse of the Sun on March 27 and will be invisible in this country. The path of the annular eclipse begins in the Antarctic Ocean and crossing the Pacific Ocean ends in the middle of South America.

Planets during March 1941.—Mercury which will be visible as a morning star throughout the month, will be stationary on March 10 and will attain greatest elongation west of the Sun on March 25 when its angular distance is 28°W. Venus will be too near the Sun to be conveniently observed. Mars rises about a couple of hours after midnight and can be seen as a reddish star of the first magnitude in the constellation Sagittarius.

After conjunction on February 21, Jupiter and Saturn will be gradually separating from

each other and are still visible as bright objects in the western sky in the early part of the night. On the evening of March 3, the two planets will be in close conjunction with the Moon. Uranus continues to move slowly eastward in the constellation Taurus: and Neptune which is in opposition to the Sun on March 17 can be seen in the field of a small telescope very close to the star β Virginis (magnitude 3·7).

Comet Notes.—It is now several years since a comet sufficiently bright to be conspicuously visible to the naked eye, has made its appearance. About the end of last month, a fairly bright comet with a considerable tail was noticed in the south-western sky immediately after sunset; the object has been, since then, widely observed in India and Ceylon, and has attracted popular attention.

On February 4, the comet was about 5° south of the star β Ceti (magnitude 2·24) and has been moving rapidly in a north-easterly direction at the rate of two or three degrees per day. The tail appears to have been about 6° long at the end of last month and is slowly

Comet (1940 *d*)

Nizamiah Observatory :—Photograph taken with 4-inch astro-camera. 1941 February 7. Exposure 70 minutes. The telescope was driven to follow the comet and on account of its rapid motion during the exposure, the stars are shown as short trails on the photograph

diminishing in length; on February 11, it could be traced to a distance of two degrees. The comet is now receding from the Sun and becoming fainter, the magnitude according to an observation on February 10 was estimated to be between 5 and 6. It is likely to be visible for some days more with telescopes of moderate size.

T. P. B.

ANNOUNCEMENTS

Tuberculosis Association of India.—The Annual General Meeting of the Association will take place at the Viceroy's House, New Delhi, on the 25th March 1941, at 6 p.m. It will be open to the members of the Central Association.

Tin Research Institute.—Since October 1940, *The International Tin Research and Development Council* has changed its name to the *Tin Research Institute*. It continues to be controlled and supported by a committee representing tin producers in the Belgian Congo, Bolivia, French Indo-China, Malaya, the Netherlands East Indies, Nigeria and Thailand. The well-known quarterly review which gives scientific and technical information relating to the production and uses of tin, its alloys, and chemical compounds, are being issued by the *Tin Research Institute*.

We acknowledge with thanks the receipt of the following:—

"Journal of Agricultural Research," Vol. 61, Nos. 1–2.

"Indian Journal of Agricultural Science," Vol. 10, Pt. 6.

"Journal of the Annamalai University," Vol. 10, No. 2.

"Journal of Chemical Physics," Vol. 8, No. 12.

"Journal of the Indian Chemical Society," Vol. 17, No. 10.

"Comptes Rendus (Doklady)," Vol. 27, Nos. 5–6.

"Experiment Station Record", Vol. 83, No. 5.

"Indian Forester," Vol. 67, No. 2.

"Indian Farming," Vol. 2, No. 1.

"Indian Central Jute Committee (Bulletin)," Vol. 3, No. 10.

"Review of Applied Mycology," Vol. 19, Pt. 11.

"Journal of Nutrition," Vol. 20, No. 6.

"Journal of the American Museum of Natural History," Vol. 46, No. 5.

"Journal of Research" (National Bureau of Standards), Vol. 25, Nos. 4–5.

"Sky," Vol. 5, No. 3.

"Science and Culture," Vol. 6, No. 8.

"Indian Trade Journal," Vol. 140, Nos. 1804–1807.

"Indian Journal of Veterinary Science and Animal Husbandry," Vol. 10, Pt. 4.

BOOKS

1. "The Ring Index" by Austin M. Patterson and Leonard T. Capell. (Reinhold Publishing Co., N.Y.)

2. "A Text-book of Sound for B.Sc. Students" by R. N. Ghosh and R. N. Rai. (Indian Press, Ltd., Allahabad.)

3. "The Biochemistry of Symbiotic Nitrogen Fixation" by Perry W. Wilson. (University of Wisconsin Press.)

ACADEMIES AND SOCIETIES

Indian Academy of Sciences (Proceedings)

January 1941, SECTION A.—SIR C. V. RAMAN: *Crystals and photons.* The incident radiation excites the crystal vibrations of which the phases are everywhere in coherent relationship with the phase of the radiation field. The scattering of light or the reflection of X-rays with change of frequency appears as the result of the phase of the lattice vibrations varying from point to point in such a manner that the crystal is, in effect, an optically stratified medium giving a monochromatic reflection of the incident rays at the appropriate angle of incidence determined by the spacing of the stratifications and the wave-length of the incident radiation. H. J. BHABHA AND B. S. MADHAVA RAO: *The scattering of charged mesons.* On the basis of the assumption put forward by Bhabha that the heavy particles can exist in states of all integral charge, it is shown that the scattering of charged mesons completely corresponds with the classical theory. B. D. SAKSENA: *Raman spectrum of gypsum.* The polarisation studies and the results obtained with polarised incident light completely satisfy the selection rules for a monoclinic crystal. R. D. DESAI, ABDUL HAMID AND H. P. SHROFF: *Studies in naphthalene series. Part VI. Synthesis of 2-propyl-1-naphthol and properties of 2-propionyl-1-naphthol.* R. D. DESAI AND W. S. WARAVDEKAR: *Studies in naphthalene series. Part VII. Attempted synthesis of 4-stearyl-, 4-palmityl-, and 4-lauryl-1-naphthols.* B. KRISHNASWAMY AND T. R. SESHADRI: *Synthetic experiments in the benzo-pyrone series. Part III. Syntheses of coumarino- and flavono-a-methyl-7 : 8-dihydrofurans.* A fresh method for building up furan rings on to coumarin and flavone compounds has been studied. (LATE) N. W. HIRWE AND P. Y. KULKARNI: *Studies in chloral amides—Part VII.* S. PARAMASIVAN: *Electrolytic restoration of bronze statues and inscribed copper-plates.* K. VENKATESWARLU: *Relative intensities of Stokes and anti-Stokes Raman lines in crystals.* MISS IONE N. D. DASS AND J. D. TEWARI: *The effect of unsaturated chromophores on pyronine dyestuffs. Part II. Dyes obtained from maleic and succinic acids.* GURDAS RAM AND V. I. VAIDHIANATHAN: *On capillary forces in natural soils.* The capillary theory of a bundle of tubes cannot apply to natural soils and conclusions derived from such a consideration must be wrong. HANSRAJ GUPTA: *An important congruence.*

SECTION B.—SIR C. V. RAMAN: *Crystals and photons.* N. KRISHNASWAMY AND G. N. RANGASWAMI AYYANGAR: *An autotriploid in the pearl millet* (Pennisetum typhoides *S. and H!*). T. S. RAGHAVAN AND V. K. SRINIVASAN: *Morphological and cytological studies in the scrophulariaceæ. III. A contribution to the life-history of* Ilysanthes parviflora *Benth.* JOSE PEREIRA: *On a trypanosome found in the blood of* Uroloncha striata *L.* T. PRASANNASIMHA ROW: *The range of variation of normal eye tension and the relation between blood pressure and eye tension.* A. ANANTHANARAYANA AYER: *Facial musculature of semnopithecus entellus.* T. S. RAMAKRISHNAN: *Studies in the genus Colletotrichum. 1. Saltation in* Colletotrichum capsici *(Syd.).* S. N. DAS GUPTA, G. S. VERMA AND S. SINHA: *Studies in the diseases of* Mangifera indica *Linn. Part III. Investigation into the effect of sulphur dioxide gas on the mango fruit.*

Indian Chemical Society: (*Journal*)

October 1940.—K. V. VIJAYARAGHAVAN: *Mercury diallyl and allyl mercuric halides.* (MISS) ASIMA MOOKERJEE: *On the bitter principles of* Citrus decumana. S. M. SETHNA AND R. C. SHAH: *Kostanecki-Robinson Reaction—Part III. Benzoylation of Orcacetophenone and its monomethyl ether.* MAHAN SINGH AND ARJAN SINGH: *Magnetic susceptibility and optical rotatory powers of p-hydroxy-a-naphthyliminocamphor.* PHANINDRA CHANDRA DUTTA: *A new synthesis of hexahydro-isophthalic acid.* PHANINDRA CHANDRA DUTTA: *Studies in the cyclopentane series—Part I. Synthesis of 1-methylcyclopentane-1 : 2-dicarboxylic acid in cis- and trans-forms.* K. N. GAIND. J. N. RAY AND BADRI SARIN: *Synthesis of new local anæsthetics—Part V.* PRODOSH CHANDRA RAY-CHOUDHURY: *Complex chromium selenates.* SRIDHAR SARVOTTAM JOSHI AND DUSHYANT NARASINGASA SOLANKI: *The influence of temperature on the electrical conductivity and viscosity of aqueous mercuric chloride.*

Geological Institute, Calcutta: (*Journal*)

The recent number (Vol. III) of the Journal *Bhu-Vidya* of the Geological Institute, Presidency College, Calcutta, contains a number of articles of varied interest such as the Economic Deposits of Bengal (by S. C. Guha), Marine Transgressions (by S. K. Ray), An Abandoned Gold Mine in S.E. Wynaad (by J. Sen Gupta), etc. The Journal also gives a Report of the several activities of the Institute during 1939–40 under the Presidentship of Dr. P. K. Ghosh, of the Geological Survey of India.

ERRATA

1. *Vol.* 9, *No.* 12, *December* 1940: Contribution entitled, "Tetraploid Til (*Sesamum orientale* L.) from Colchicine Treatment", page 542; legend under Fig. 1, *for* "Deploid Sesam" *read* "Diploid Sesame"; under Fig. 2, *for* "Tetraploid Sesam" *read* "Tetraploid Sesame".
2. *Vol.* 10, *No.* 1, *January* 1941: Note entitled "Production of Fruit-bodies of *Agariceus polyporus* Berk. in Artificial Culture", page 26, 2nd column in the heading of the note *for "Agariceus polyporus* Berk." *read "Polyporus agariceous* Berk."; line 20 of the same note *for* "Polyporus culture" *read* "Polysporus culture".